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Development a Theoretical Framework to Measure The Quality in The Jordanian Construction Projects

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Dedication

I dedicate this work to those who grant me endless love, and support.

To my dear **father** who has been a source of encouragement and inspiration to me throughout my life.

To my **mother**, **brothers** and **sisters** for continuous support, I will always appreciate all what they have done.

A special feeling of gratitude to my loving fiance for his patience and enthusiasm.

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Aswan Sabrie Al-Dalaeen

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List of Abbreviations

QA	Quality Assurance
QC	Quality Control
QM	Quality Management
ISO	International Organization for Standardization
BS, EN	British Standard European Norm
ASCE	American Society of Civil Engineers
ASQ	American Society for Quality
TQM	Total Quality Management
QMS	Quality Management System
RII	Relative Importance Index
GNP	Gross National Index
Et al	et alii or et aliae also known as and others
SPSS	Statistical Package the Social Sciences

Abstract

Development a Theoretical Framework To Measure The Quality in The Jordanian Construction Projects

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This study aims to provide owners, contractors, project managers and designers with the necessary information to improve management quality in construction projects, through assessing the factors that affect the quality views of the contractor and the owner, by comparison of perspectives, this study covered the most important 12 factors affecting quality, plus 51 sub-factors influencing quality directly. In order to develop a framework for measuring quality in Jordanian construction projects.

A survey methodology is applied by questionnaire to collect data from contractors and owners in Jordan, where the number of participants in this study was 83 participants: 41 contractors and 42 owners. Descriptive analysis was used to achieve the objectives of this study; the results of this survey were used for the most important ranking factors for contractors and owners through the Relative Importance Index (RII).

The finding indicate that, no significance statistical differences in both viewpoints, where the most important factors: raw materials, equipment, contract, Workers in the project and the manner of implementation of the project. This study has made several recommendations, including the need to use a system of quality management in construction projects.

الملخص

وضع إطار نظري لقياس الجودة في المشاريع الإنشائية الأردنية

أسوان صبري الضلاعين

جامعة مؤتة، 2015

تهدف هذه الدراسة إلى تزويد المالكين والمقاولين ومدراء المشاريع والمصممين بالمعلومات الضرورية لتحسين إدارة الجودة في المشاريع الإنشائية وذلك من خلال تقييم العوامل التي تؤثر على الجودة من وجهة نظر المقاول والمالك والمقارنة بين وجهتي النظر،حيث شملت هذه الدراسة أهم 12 عامل من العوامل المؤثرة بالإضافة إلى 51 عامل فرعي، يؤثرون على الجودة بشكل مباشر. وبالتالي وضع إطار لقياس الجودة في المشاريع الإنشائية الأردنية.

تم تطبيق المنهج المسحي بتوزيع استبانه لجمع البيانات من المقاولين والمالكين في الأردن حيث كان عدد المشاركين في هذه الدراسة 83 مشارك : 41 مقاول و42 مالك، وقد تم استخدام التحليل الوصفي لتحقيق أهداف هذه الدراسة، وتم استخدام نتائج هذا الاستبيان لترتيب العوامل الأكثر أهمية عن طريق مؤشر الأهمية النسبي (RII).

توصلت هذه الدراسة إلى عدم وجود فروق ذات دلالة إحصائية في وجهتي النظر حيث كانت أهم هذه العوامل المواد الخام، المعدات، العقد، العاملين و طريقة تنفيذ المشروع. قدمت هذه الدراسة عدة توصيات من أهمها ضرورة استخدام نظام لإدارة الجودة في المشاريع الإنشائية.

Chapter One
Introduction

1.1 Overview

Quality has become a very popular subject in recent years due to conceptual changes in the industry. Quality is a topic which has been receiving increasing attention worldwide. The need for achieving quality of the finished product in the building construction is very important.

Construction is the one of industries which national prosperity depends on it (Ejaz et al, 2013).

Construction industry is a complex in its nature because it comprises large numbers of parties as owners(clients), contractors, consultants, stakeholders, and regulators. This industry is one of the largest industries and contributes to about 10% of the gross national product (GNP) in industrialized countries (Navon, 2005). Jordan is no exception, the local construction industry is one of the main economic engine sectors, supporting the Jordanian national economy, local contractors participate in the construction of public development projects including large scale infrastructure, such as: terminals, highways, telecommunications, irrigations, waste disposal and treatment, properties, public housing, and industrial buildings.

As per mentioned by American Society for Quality in the year 2000 technically quality could also defined as "characteristic of product or service that bear on its ability to satisfy stated or implied needs and the product or service free of deficiencies".

Quality of the facility built by the main contractor is directly related to the quality of resources and works provided by various parties, designers, suppliers, and subcontractors. Supplier management entails the creation of supplier partnerships involving the selection of suppliers on the basis of quality instead of solely on price (Seraph et al. 1989).

Process management involves the inclusion of quality measures in the construction processes, and continuous monitoring and control of those processes (Claver et al, 2002).

According to Feigenbaum, (1990) in an increasingly competitive world quality is no longer an optional extra; it is an essential business strategy for survival.

Quality measurement is the trigger for quality improvement. The things which can't be measured can't be improved. It represents increasingly important concerns for project managers.

The role of quality management for a construction company is not an isolated activity, but intertwined with all the operational and managerial processes of the company, the quality management is critically required for

a construction company to sustain in current construction market which is highly challenging and competitive (Tan & Abdul-Rahman, 2011).

Quality management has increasingly been adopted by construction companies as an initiative to solve quality problems and to meet the needs of the final customer (Kanji &Wong, 1998).

Harris and McCaffer (2001), explained that quality management has to provide the environment with related tools, techniques and procedures that can be deployed effectively leading to operational success for a company.

In this study, it will be studied the factors influence on quality in the Jordanian Construction Projects, it can be used to measure the quality in construction projects.

"Quality was initially introduced to the world by the first father of quality, Dr W Edwards Deming ,followed by Dr. Joseph M Juran and now the father of total quality control is Dr. Armand Val Feigenbaum. Initially, during the beginning of revolution industry, the quality idea was established for larger scale and expensive item which only the rich involved. But when things around changes and quality was set as a bench marking options to make a selection then this would be an ultimate marks" (Palaniandy, 2011).

The purpose of this study is to evaluate the factors influencing on quality in construction projects from the perspective of owners and contractors, This will lead to examine the requirements for development of a framework to measure the quality in construction projects leading to more effective involvement of stakeholders in quality planning and practices thus ultimately contributing to higher quality outcomes for construction projects. Through an extensive literature review it highlights various perceptions of quality, categorizes quality issues with particular focus on benefits and shortcomings and also examines the viewpoints of major stakeholders on project quality. It proposes a set of criteria to be used as a basis for a quality practice improvement framework, which will provide project managers and owners with the required information and strategic direction to achieve their own and their stakeholders' targets for implementation of quality practices leading to the achievement of improved quality outcomes on future projects.

1.2 Problem Statement:

Today, quality improvement is the biggest challenges faced the world in general and the Hashemite Kingdom of Jordan in particular. This challenges as a result of many things accumulated reached to this situation. One of the most important of these things is the lack of quality measurement methods**.** Quality management will be more critical tomorrow, without proper guidance and direction.

The need for achieving quality of the finished product in the building construction is very important. Quality is an essential element for sustainability and customer satisfaction.

Quality in its simplest form can be defined as meeting the customer expectations, or compliance with customer specification.

In construction industry there are a number of problems related to the bad quality control. Projects are frequently late, over budget and suffer from poor workmanship and materials. Defects or failures in constructed facilities can result in very large costs, even with minor defects, re-construction may be required and facility operations impaired, increased costs and delays are the result.

Surprisingly, little research has been done in Jordan focused on quality in construction projects. Measuring Quality for construction projects is a complex problem. Every project is unique in terms of design specifications, delivery methods, administration, and participants. Therefore this study will determine the construction industry's viewpoint on the factors which would improve construction quality in Jordan and the relative effect of each factor, is an essential first step towards establishing a framework to measure the quality in the Jordanian Construction Projects and to improve the quality in construction projects.

The problem of this study can be summarized by answering the following questions:

1. What is quality? what is the relative importance of factors influencing on construction quality?
2. How to obtain quality?
3. To what extent the management of construction companies is perceived as committed towards quality management implementation?
4. How to measure quality in construction projects?
5. What are the roles of management towards producing better quality in construction projects?
6. What is the perception level of owners and contractors about the influence degree of factors on the quality of Jordanian construction projects?

1.3 Objectives of the Study

The objectives of the study are set as follow:

1. To develop a theoretical framework to measure the quality of construction projects.
2. To identify and evaluate various factors influencing the quality of construction projects in Jordan, and to elicit perceptions of their relative importance.

3. Assess the relative importance of these factors from the owners, and contractors perspectives.
4. Improve the quality in construction projects.
5. Submitting a contribution for how to apply the principles of quality management in the construction projects.

1.4 Hypothesis of the Study

1. There is a significant difference in perception between contractors and project owners with regard to factors affecting quality.
2. The project owners give more importance for quality factors than the contractors.
3. There is a significant difference in perception between contractors and project owners with regard to high quality will lead to increase in total cost of projects.
4. There is a significant difference in perception between contractors and project owners ,with regard to the roles of management for producing better quality in construction projects.

1.5 Importance of the Study

The importance of the study and its contribution to the literature:

1. It's one of the few studies in Jordan, which discussed the quality in construction projects.
2. This study would be a help to be a guide for construction practitioners such as owner, contractors with others, to understand and also to provide suitable and acceptable quality for the best of the construction based consumers in Jordan.
3. There is a need to develop a framework to measure quality due to lack of quality measurement methods.
4. Construction projects are an important priority in Jordanian's national plans and playing a pivot role in improve social living standards.
5. The high cost of buildings makes it necessary to develop framework to ensure quality of the finished product.
6. Provide clients, project managers, designers, and contractors with necessary information needed for a better quality management of construction projects.

1.6 Jordanian Construction Sector

The construction sector is one of important economic sectors where a variety of subsectors are interrelated with a number of other sectors, making it more vulnerable to economic , demographic and social changes.

The activity of the real estate market has direct and significant impact on construction sector as a key driver for it.

The construction sector has experienced steady development in the last decade where growth is affected by many factors as general political climate , secure investment environment, and good infrastructure. The Ministry of Public Works is currently working to organize the construction sector since the government was studying a modern law that is concerned with the regulation of the construction industry.

The construction sector includes the following activities:

1. Preparing and creating the site .
2. Construction of buildings and civil engineering projects.
3. Installations in buildings.
4. Completing buildings.

The number and size of facilities:

Total establishments operating in the construction industry registered in the three chambers of industry (Amman, Zarqa, Irbid) 2012 about 2,778 local facility compared to the number in 2011 where the number of enterprises registered was 2702 ,achieving a development in number by 2.8% , this difference in both industrial and craft sector.

Employment Size:

The total number of workers in enterprises operating in the construction industry registered in the three chambers of industry (Amman, Zarqa, Irbid) 2012 was 14722 workers, compared to 15890 workers in 2011, registering a negative growth in number by 7.4% and this difference is in both industrial and craft sector.

Quality, Standardization and Metrology:

The elements of quality, standardization and metrology are of the most important elements that differentiate the product and enhance its competitiveness, many large enterprises and SMEs sector installations comply with quality requirements and standards in order to achieve the highest quality, but a number of medium-small enterprises and craft enterprises in particular, may not be able to create an integrated system for quality control due to financial and administrative costs required by such systems, which leads to an obstacle in raising productivity and the evolution level in its products. (Source from Jordan Chamber of Industry, 2015).

The following table (1.1, 1.2) Refers to the number of contractors registered by the government as well as the number of construction contractors classified (Jordanian Constructions Contractors Association, 2014).

Table (1.1)
The number of registered contractors in governments during the year of 2014

No. of Contractors	Government
1620	Amman
236	Irbed
206	Al-kerak
64	Al-Tafeela
48	Al-Aqaba
69	Al-Mafraq
187	Al-Zarqa
20	Ajloun
110	Al-Balqa
32	Jerash
41	Maa'n
71	Madaba

Table (1.2)
The number of classified contractors in the construction projects during the year of 2014

No. of contractors	Class
85	First
62	Second
154	Third
769	Fourth
385	Fifth

1.7 Operational Definitions

Project: Any series of activities or tasks that have specific goals must be accomplished within specific specifications and have a specific start and end , the funding and the use of different sources of funds, time, equipment and labor.

Project Partners: Stakeholders in the project that each plays a direct or indirect role in the completion of the project , their roles complement each other to achieve project objectives.

Owner: The funder of the project, he has the right of control throughout the stages and decisions affecting the project within the limits of his powers, the responsibility for the selection of the rest of the project stakeholders , he can delegate some of his powers to one of the projects parties.

Contractor: The contracted by the owner and entrusted with the implementation of the project in whole or in part and he may be a person or a company.

1.9 Organization of the Study

The study is structured as follow:

Chapter One: Introduction that includes the problem statement, objectives of the study and importance of the study.

Chapter Two: literature review and theoretical framework, this chapter reviews the relevant literature and present previous studies, we present different definitions about quality, quality factors, quality management, quality in construction projects. Finally we find the previous studies related with this thesis.

Chapter Three: Design and Methodology, this chapter describes the methods that were used for making the survey, the questionnaire structure as well as the method for choosing the sample of population is also described, finally present the validity and reliability of questionnaire.

Chapter Four: presents statistical analysis, discussion of the results.

Chapter Five: conclusions, recommendations, limitations and future works.

This chapter introduces the main gate to the subject of thesis, it covers the problem statement, objectives, the hypothesis, importance of the study and the research orientation. It will be the real entrance to the thesis.

Chapter Two
Literature Review

This chapter provides an overview of quality in general with its concept and quality management in construction projects. Also reviews relevant prior studies.

2.1 Quality History and Development

Quality is an old concept as old as civilization. Pyramids built around 2500Bc,show a high degree of accuracy in its dimensions. Anyway using tolerance systems for the specification of quality and statistical principles to monitor quality are of recent origin (Ashford, 1989).

The existence of issues of quality was since tribal chiefs, kings, and pharaohs ruled. one of the first record uses of statistics was by Nrmer, king of the north, in ancient Egypt, approximately 1450 B.C, dimensions of stone blocks were checked by inspectors .The uniformed methods and procedures and precise measuring devices led to the Egyptian's success. Since variation in materials, craftspeople and tools existed, some method of quality control was necessary (Gitlow et al, 2005).

In modern industry, quality practices were evolved and developed alongside with the manufacturing practices. These practices have evolved through various stage from operator quality control, foremen quality control, inspector quality control, statistical quality control, total quality control, and total quality management (Hassan et al, 2000).

In the late nineteenth and early twentieth century, an American industrial engineer named Frederick Taylor formulated a new approach to factory management called "scientific management". According to his philosophy, human performance could be defined and controlled through a set of standards and rules related to work, which could increase productivity without increasing the number of skilled craftsmen needed at a factory. Taylor's scientific management system, was a product of time, which evolved during an era of mass immigration, when the American labor system was being flooded with unskilled, uneducated workers, as well as lacked advanced skills in English for the majority of them. Taylor believed that his system provided an efficient way to employ these laborers in large numbers, as well as to reduce labor conflict and disputes. His program of scientific management would leave little discretion to either workers or supervisors, leading to a rule-bound management style, which despite its high productivity could be rigid and slow to adjust to market conditions (Gitlow et al, 2005).

apprenticeships and guilds developed. craftsmen whether trainers or inspector have to know their trades, their products, and their customers, in order to built quality into their goods. Knowledge of these elements make

them pride of their work and they have to train others to do quality work. The government could inspect all the products so as to establish quality standard (Taylor,1989).

2.2 Quality Concept/Definitions

There are many definitions of quality available in the literature. It has been defined in many different ways by different people (Hassan et al, 2000).

A definition attributed to quality gurus state the following:

(Crosby, 1979) defined Quality as "conformance to requirements" , putting in mind that this definition assumes that the specifications and requirements have already been developed. Crosby believes that quality is not comparative (high quality or low quality) but it should be judged as (conforms to requirements or does not conform to requirements), (McCabe, 1998).

Juran, (1964): said that Quality is "fitness for use", and Juran, (1988): defined Quality as "conformance to specifications".

The ISO 9000, (2000) defined quality as "all the features and characteristics of products or service needed to meet satisfaction".

Feigenbaum (1983) stated the quality is the Total composite will meet the expectation the customer.

W. Edwards Deming, (1982) said that good quality means a predictable degree of uniformity and dependability with a quality standard suited to the customer. And he defined the quality is the degree to which performance meets expectations.

According to (Stasiowski and Burstein, 1994) Some design professionals said that the quality could be measured through aesthetics point of view. This definition is based on the facilities design and to what degree this design blends to the building surroundings, the psychological impacts of the building on the people live in , the ability of a landscaping design to match the theme of adjacent structures, and the use of bold new design concepts that capture people's imaginations. Because aesthetic definition of quality is largely subjective, major disagreements arise as to whether quality has been achieved or not. Since objective definitions of aesthetic quality do not exist and differ from one person to another, design professionals generally take upon themselves to define the aesthetic quality of their designs.

In the construction industry, quality can be defined as meeting the requirements of the designer, constructor and regulatory agencies as well as the owner. According to an American Society of Civil Engineers (ASCE) study (Ferguson and Clayton, 1988). The main characteristics of Quality are as follows:

1. To meet the requirements of the owner like adequacy, completion on time and within allocated budget, life cycle costs, and operation and maintenance.
2. To meet the requirements of the design professional concerning provision of well-defined scope of work, budget allocated to assemble, hiring qualified and trained and experienced staff, budget allocated to obtain adequate information prior to design, provisions for timely decisions by owner and design professional, and contract to perform necessary work at a fair fee within adequate and specific time.
3. To meet the requirements of the constructor concerning provision of contract plans, specifications, and other documents prepared in sufficient detail in order to prepare priced proposal or competitive bid by the constructor, timely decisions by the owner and design professional on authorization and processing of change orders, fair and timely interpretation of contract requirements from field design and inspection staff, and contract fixing adequate date to perform the required work on a reasonable schedule which leads to a reasonable profit.
4. To meet the requirements of regulatory agencies like public safety and health, environmental considerations, protection the public property including utilities, and conformance with applicable laws, regulations, codes and policies.

Based on manufacturing, (McCabe,1998) defined quality as "outcome of process concerning engineering and manufacturing".

In addition, differentiation between 'quality in fact' and 'quality in perception' should be clear and obvious. Quality in fact is achieved when services or goods meet specification, while quality in perception is achieved when services or goods meet customer's expectations (Culp, 1993).

Quality policy: is an overall intent and trends of an organization regards to quality, as expressed by high level Management (McCabe, 1998).

According to (Harris and McCaffer, 1995), a comprehensive quality system in construction include:

1. Communicate current instructions to all obviously.
2. Abilities Proper capabilities and skills, therefore training.
3. Appropriate, safe and efficient equipment.
4. The convenient of site working conditions, with suitable inspection.
5. Completed work should be checked , and tested, and recorded.
6. Authority’s power to amend to correct faults.
7. Motivation should be existed to produce quality.
8. Documentation for the system to register pass/fails

9. Making sure that defects have been amendments.

Quality System is defined in BS, EN, ISO 8402 as " Organizational structures, procedures, processes and resources for implementing quality management" (McCabe, 1998).

2.3 Service Quality

The customers' point of view should be taken into consideration when describing the concept of Service Quality as they may have different values, different ground of assessment, and different circumstances (Chang, 2008).

(Maloney, 2002) said that the service quality could be adopted in the construction industry.

(Parasuraman et al, 1990) mention that the service quality should be based on the experience of the customer about the service he perceived.

Service quality should be involved not only in the final product but also in the production and delivery process. Hence, employee involvement in process redesign and commitment is very important to produce final tourism products or services (Kumra, 2008).

(Parasuraman et al, 1985) suggested 10 dimensions for service quality:

1. Access: the way via the customer can contact the construction company should be easy.
2. Credibility : commitment of the company to do "what it says it will do".
3. Reliability : commitment of the company that the construction activities will be correct.
4. Competence : the ability of the company to carry out the service offered to the customer
5. Courtesy : the employees of the company should show a high degree of respect, politeness, kindness and consideration to the customer
6. Communication : the ability to send information about the construction project to the customer
7. Understanding the customer: the company should be able to comprehend customer needs and offer personalized attention to him.
8. Responsiveness : the company should be able to solve problems that have arisen during the implementation of the project.
9. Security : customer information must be kept confidential and secret.
10. Tangibles: the appearance of both the personnel and the facilities of the company to the customer

2.4 Product Quality:

There is a difference between product quality and process quality. The product quality is the process that leads to accept the product or not, while process quality may refer to achieving quality in the way the project is organized and managed in its three phases: planning and design, construction, and operation and maintenance, (Nagasaku, 1965).

(Gravin, 1984) identifies eight principal for product quality dimensions:

1. Performance: it means the features of the product's utilizing.
2. Features: the properties and characteristics of a product.
3. Reliability: the ability of a product’s to continue over a particular period of time through standard conditions of use.
4. Conformance: what is the degree of conformity between the structure and performance features of a product, and pre-stated standards.
5. Durability: the period of use and benefit from the product before it physically crumbles or until changing is better.
6. Serviceability: the speed, courtesy, and competence of repairing and maintenance.
7. Aesthetics: the look of the product from customer's view.
8. Perceived quality: subjective estimation coming out from image the customer perceived, and from advertising and brand names.

2.5 Quality Control (QC) and Quality Assurance (QA)

ISO 9000, 2005 Defined the quality control is "The operational techniques and activities used to fill full requirements for quality".

Juran, (1988) states that’s Quality Control (QC) is the particular application of the quality assurance program and related activities.

Effective QC minimizes the possibility of changes, faults and omissions, which leads the fewer conflicts and disputes (Arditi et al,1999).

The functionality of quality control is closest to the product in that various techniques and activities are used to monitor the process and to pursue the elimination of sources that lead to unsatisfactory quality performance (Wick, 1993).

Quality control is very important to a successful construction project and should be adhered to throughout a project from conception and design to construction and installation. Inspection during construction will prevent costly repairs after the project is completed. The inspector, engineer, contractor, funding agency, permit agency, and system personnel must work together to inspect, document, and correct deficiencies (Satterfield, 2005).

According to (Mitra ,1998) The quality control system advantages:

1. Improvement in the quality of products and services.

2. The system is continually evaluated and modified to achieve the changing needs of the customer.
3. Quality control system improves productivity.
4. Improved the delivery dates, the lead time for producing parts and subassemblies will reduce when improved the productivity.

ISO 9000, 2005 Defined the Quality Assurance “All the planned and systematic activities implemented within the quality system that can be demonstrated to provide confidence that a product or service will full fill requirements for quality”. It is a part of quality management.

Quality assurance support a good protection versus quality problems through early warnings of trouble ahead. Such early warnings play an essential role in the prevention of both internal and external problems in projects (Arditi et al,1999).

A Quality Assurance program is defined as “The sum total of the activities aimed at achieving that required standard” (ISO, 1994).

Developing and monitoring the activities within the quality assurance program in the construction phase are the joint responsibility of either the designer or the construction management firm depending on the project delivery system in use (Wick, 1993).

Juran, 1993 stated that QA involves establishing project related policies, procedures, standards, training, guidelines, and system necessary to produce quality.

Tengan, C., (2007) identify lack of technical and professional expertise and resources to perform task, lack of employee commitment and understanding, lack of education and training to drive the improvement process when he studied the quality assurance practices of some selected construction firms in the Kumasi metropolis in Ghana.

According to the Manual of Professional Practice for Quality in the Constructed Project, "Quality Assurance (QA) is a program covering activities necessary to provide quality in the work to meet the project requirements" (Ferguson and Clayton1988).

Storey et al, 2000 underlines that The components of a Quality Assurance program are often grouped into three levels:

1. The organizational level: dealing with the quality policy and objectives.
2. The tactical or functional level : dealing with general practices as training, facilities, operation of QA .
3. The operational level : dealing with the Standard Operating Procedures worksheets and other aspects of updated operations.

The difference between the quality control and quality assurance (Mitra ,1998):

1. Quality control verifies whether particular attributes are in, or are not in, a particular product or service.

2. Quality control identifies faults for the primary purpose of correcting faults.
3. Quality control is the responsibility of the team work.
4. Quality assurance helps establish processes and identifies weaknesses in processes and improves them.
5. Quality assurance sets up measurement programs to evaluate processes.
6. Quality assurance is a management responsibility, frequently performed by a staff function.
7. Quality assurance is concerned with all of the products that will ever be produced by a process.

Table 2.1 below provides the difference between quality assurance and quality control (ISO 9000, 2005).

Table (2.1)
Difference between quality assurance &quality control
Source: ISO 9000,2005

Quality Assurance	Quality Control
Process	Product
Pro-active	Re-active
Staff Function	Line Function
Prevent the defects	Find the defects
Quality audit	Walk through
Defining process	Testing
Selection of tool	Inspection
Trainings	Check point review

2.6 Total Quality Management

TQM defined as a Constant pursuit for excellence through the creation of appropriate skills and attitudes in people to make prevention of defects possible and satisfy customers or users totally at all times. TQM is an organization wide activity that has to reach every individual within an organization (Lakhe and Mohanty,1994).

Oakland, 1989 has defined TQM as follows: "Total Quality Management (TQM) is an approach to improving the effectiveness and flexibility of business as a whole. It is essentially a way of organizing and involving the whole organization; every department, every activity, every single person at every level".

TQM has been based on the quest for progress and continual improvement in the areas of cost, reliability, quality, innovative efficiency and business effectiveness. Pfau (1989) states that TQM is an approach for continuously improving the quality of goods and services delivered through the participation of all levels and functions of the organization.

Tobin, (1990) views TQM as the totally integrated effort for gaining competitive advantage by continuously improving every facet of organizational culture.

Sink, (1991) states that TQM can be successful only if the operational definition is translated into strategies by the leadership of the organization and which are crystallized into actions and communicated to all the people with conviction and clarity.

The success of TQM depends on the genuine commitment to quality of every member of the organization (Evans and Lindsay,1992).

Successful TQM program should have the following attributes (Olomolaiya and Jayawardane, 1998):

1. Committed leadership of the highest standard during the life time of the organization.
2. Training targeted to every level of management and employees.
3. Teamwork, which means that everyone participate in the improvement efforts.
4. Upstream prevention management which requires seeking out potential problems and not merely waiting for a failure to happen before effecting improvement.
5. Ongoing prevention action requiring the need to attack constantly the real root causes of problems.
6. Improved communication to make sure that all required information is supplied at the correct level, at the correct time and to the required degree of detail.
7. Clearly identified vision, mission and goals.
8. Focus on employees to include carrier development plans, profit sharing, enhancing training, employee involvement and recognition, employee satisfaction is indispensable in TQM.

According to Strolle (1991) creating a TQM culture is the responsibility of everyone in the organization. It is not restricted to the individual or group.

Price and Gaskill (1990) have identified three dimensions of TQM. They are:

1. The product and service dimension: the degree to which the customer is satisfied with the product or service supplied.
2. The people dimension: the degree to which the customer is satisfied with the relationship with the people in the supplying organizations.
3. The process dimension: the degree to which the supplier is satisfied with the internal work processes, which are used to develop the products and services supplied to the customers.

2.7 Quality in Construction Project

(Ireland, 1985) aimed at investigating the contributions of managerial actions to reduce time and cost as well as to increase and improve quality, which may help improving and developing project performance.

The construction sector plays a dominant role, and stand responsible for building new houses, apartments, factories, offices and schools. It also builds roads, bridges, ports, railroads, sewers and tunnels, among many other things. In addition, it maintains and repairs all of those structures and produces the basic materials such as concrete that are used to make them. The industry's significance is due not only to the fact that it provides the buildings and infrastructure on which virtually every other sector depends on, but to the fact that it is such a major sector in its own right (The Business Roundtable, 1983).

(Abdel-Razeq et al, 2001) stated that the construction process consists of three stages: construction inputs, construction processing, and construction outputs. **C**onstruction inputs include all resources and parties involved in the construction process like materials, tools and equipment, workers, supervisors. **C**onstruction processing is the execution process, which can be defined as activating construction inputs for executing construction activities. **C**onstruction output is the construction facility (project). In general, the main parties involved in construction phase are: owner, designer, general contractor, material supplier, owner's site team, and contractor's site team.

Many characteristics distinguish between construction industry and other industry. The following differences, some of them significant, must be considered when applying a quality program to construction (Rounds, 1985) :

1. All construction projects are unique. They are single order, single production products.
2. Unlike other industries, which usually have a fixed site with similar conditions for production, each construction production site always displays different conditions.
3. The life-cycle of a construction project is much longer than the life-cycle of most manufactured products.
4. There is no clear and uniform standard in evaluating overall construction quality as there is in manufactured items and materials; thus, construction projects usually are evaluated subjectively.
5. The participants in the construction project owner, designer, general contractor, subcontractor, material supplier, etc. differ for each project.

The construction industry represents the single largest segment of the U.S. economy. This segment represents a wide range of projects conducted every year to meet the diverse needs of owners (Russell,1991).

The construction industry is Europe’s largest industrial employer, accounting for about seven percent of total employment, and in the EU, the US and Japan combined, it employs more than 40 million people (The Business Roundtable,1983).

2.7.1 Quality of Codes and Standards

According to the ASCE manual, the primary function of codes and standards is to protect the safety and public's health. Compliance with codes and standards should be an issue addressed early in the design phase. Without early identification of the appropriate codes and standards, reworking plans and specifications can result in considerable cost and delay. The design professional must be knowledgeable about the provisions of codes and standards before starting the design process because the building codes directly control the minimum standards of many components of a building project, and are responsible for much of the finished product quality (Ferguson, 1988).

Kubal,1994 claims that regulations controlling the construction process are much more restrictive than in most manufacturing and service industries.

Stasiowski and Burstein,(1994) found that quality design codes and standards with scientific principles, must achieve satisfaction for the criteria of applicable codes and standards, but also the owner's project needs. Codes and standards refer to the minimum criteria. But owners may have specific requirements.

2.7.2 Quality of Drawings and Specifications

Drawings and specifications are the two sets of documents given to the constructor that provide technical information on materials, performance of the constructed facility, and quality requirements. Drawings are the only documents given to the constructor that show the design concept, size and scope of the job, number and size of materials or items, and how they are assembled into a final project(Arditi and Gunaydin, 1997).

Oberlender,1993also underlines that the final product quality of design work is a set of contract documents (drawings and specifications) to guide the physical construction of the project. There are often inconsistencies between the drawings and specifications, (Stasiowski, 1994). That is why it is critical that drawings be clear, concise, and uniform, according (Ferguson, 1988).

Gunaydin's findings show that the quality of the drawings and specifications gained from the designer have influence on the design's quality and construction levels, and consequently the quality of the constructed project, according (Gunaydin's,1995).

2.8 Quality Management

Quality Management is a method of management that enable providing products, services or processes with specific characteristics in accordance with the standards and expectations of the clients. In ISO 9000, 9001 and 9004 standards, quality management is defined as "all activities carried out and implemented by organization so as to direct, control and coordinate quality. These activities include: formulating a quality policy, setting quality objectives, quality planning, quality control, quality assurance and quality improvement (Popa, 2011).

"W.Edwards Deming" offered an important insight and gave impetus to the quality movement. Deming's philosophy of management is summarized by 14 principles (listed below), which are required for the transformation of traditional management of any type of organization, whether it is large or small, manufacturing or service based (McCabe, 1998).

1. Create constancy of function towards developments of product and service, with a target to become competitive, retain in business and offers jobs.
2. Adopt the new philosophy, top management and everybody.
3. Cease dependence on inspection to achieve quality.
4. End the practice of awarding business on the basis of price tag.
5. Improve constantly and forever the system of production and service.
6. Institute training on the job.
7. Teach and institute leadership.
8. Drive out fear, Create trust, Create a climate for innovation.
9. Break down barriers between departments.
10. Eliminate slogans, exhortations and targets for the workforce.
11. Eliminate work standards (quotas).
12. Remove barriers that rob people of pride of workmanship.
13. Encourage education and self-improvement for everyone.
14. Take action to accomplish transformation.

Crosby's approach "Absolutes of Quality Management" and the "Basic Element of Improvement". is summarized in the following points for quality management (McCabe, 1998):

1. Quality means conformity to needs, not elegance.
2. Nothing is as a quality problem, problems must be determined and solved by those members or departments caused them.

3. Nothing is as the economics of quality, it is cheaper to do the job for the first time.
4. The cost of quality is the only performance measurement.
5. “Zero Defects” is the only performance standard.

The ISO 9000:2000 series give the following principles of the quality management (Popa, 2011):

1. Customer focus: understanding the current and future customer needs, satisfying and trying to exceed the customer needs.
2. Leadership: creating and maintaining an internal environment to involve people in achieving the goals of the organization.
3. Involvement of people : using the abilities of the people at all levels for the benefit of the organization.
4. Process approach: activities and related resources are managed as a process to obtain the result more efficient.
5. System approach to management: increasing the effectiveness and efficiency of the organization when the interrelated processes are identified, understood and managed as a system.
6. Continual improvement it should be a permanent objective of the organization.
7. Factual approach to decision making decisions are effective when they bases on data and information analysis.
8. Mutually beneficial supplier relationships enhancing the ability of the organization and supplier to create value due to interdependent and mutually beneficial relationships.

A Quality Management System (QMS) may be considered as a complex system including all the parts and components of an organization dealing with the quality of processes and products. Quality Management System can be defined as "the managing structure, responsibilities, procedures, processes, and management resources which are necessary to implement the principles and action lines in order to achieve the quality objectives of an organization". It is not an addition to an organization, but it is an integral part of its management and production (Hand book for implementing a QMS, 2000).

For the implementing a QMS (CERCO, 1999), a number of direct benefits of a QMS are stated:

1. Improved customer satisfaction.
2. Improved quality of products and services.
3. Workers’ satisfaction and more commitment to the organization.
4. Better management and a more effective organization.
5. Improve relations with suppliers.
6. Improved promotion of corporate image.

Management function determines the quality policy, objectives and responsibilities, and implement them by means such as: quality planning,

quality control, quality assurance and quality improvement within the quality system (McCabe, 1998).

2.9 Cost of Quality

The concept of Cost of Quality originated in manufacturing settings in the 1950s, as a means of justifying staff functions responsible for quality management. The cost of quality is divides into four separate categories: (Gryna, 1999).

1. Prevention Costs: which means the costs that aim to prevent future losses like; training, quality planning, process control planning, design review, and preventive maintenance of machines ……. etc.).
2. Appraisal Costs: that means the estimated expenditures with the purpose of measurement and assessment of the process like: inspection, quality check, third party audits, measuring devices, reporting systems, laboratory acceptance testing etc).
3. Internal failure costs: which are the costs incurred and paid before the delivery of the products. These costs include the resources needed to complete additional tasks, any costs involved in rework due to inadequate processes, re-inspection or retest, and material review and activity.
4. External failure costs: are those costs arise after the product is delivered to the customer, such as customer service costs, product recall, and customer returns warranty.

The cost of quality has two main components: the cost of good quality and the cost of poor quality (Crosby, 1979).

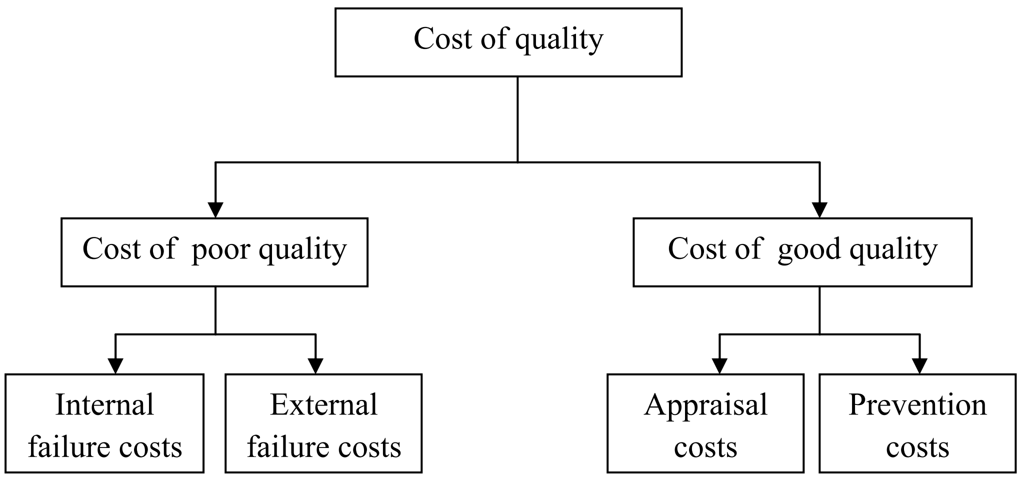


Figure (2.1)
Cost of Quality

(Pyzdek and Berger, 1996) stated that prevention is the cornerstone to improve quality and profitability. The total quality assurance fundamental approach view that increase in prevention expenditures will

generate larger savings in all other cost categories. Better prevention of poor quality will clearly reduce internal failure costs, since few defective items will be made. External failure costs will also be reduced. In addition, fewer appraisals will be required, since the products will be made correctly at the first time.

The cost of quality control may be classified in two groups (Barrie & Paulson, 1992)as follow:

1. The cost of skilled worker, equipment, materials, paths and supervision to produce quality output.
2. The costs of monitoring and verifying the quality output in correcting or replacing the work which has structure's problems.

In the construction industry, contractors are generally selected by owners on a competitive basis taking into account the following criteria: the bid which is considered the main criterion, contractors safety records, technical support, efficiency and capability of equipment, reputation regarding the quality of the work accomplished and performed by the contractor (Arditi and Gunaydin, 1997).

Contractors with poor quality reputation have little chance to be awarded projects in the existing competitive market place. Therefore, these contractors are recommended to pays for invest in measures to achieve high work quality in order to increase their chances of winning contracts (Arditi and Gunaydin, 1997).

Ireland (1985) aimed at investigating the contributions of managerial actions of reducing time and cost, and increasing quality, which may help improving project performance.

In a recent survey conducted among Indian construction professionals demanding them to arrange the five following criteria: (compliance to schedule, cost, quality, no dispute, and safety) according to their importance, he found out that quality occupied the second rank after compliance of schedule according to the vision of construction professionals (Jha, 2004).

(Hand Book for Implementing QMS, 2000) divided quality costs into two parts:

1. Investments or conformity costs which include expenditure for reducing non-quality like: training, writing quality documentation....etc).
2. Non quality costs corresponding to quality defects.

2.10 Factors Affect on Project Quality

There are many factors affecting the quality of a building construction project, but the most important among these factors are: characteristics of site layout, skill and experience of site staff, characteristics of design documents, equipment, materials, quality, and

labor management systems, the owner quick response in taking decisions, in addition to the political environment which is also among the factors effecting quality (Amer, 2002).

The study of Joy,(2014) aimed at providing clients, project managers, designers, and contractors with necessary information needed to manage the quality of a construction building projects in a best way by identify the factors that affect quality of construction projects and ranking them by degree of importance.

Table 2.2 and Table 2.3 below show the rank of the factors affect of quality by Contractors and consulting Consecutively.

Table (2.2)
The rank of the factors affect of quality by contractors

The Rank by Contractors	Quality Factors
1	Conformance to codes and standards
2	Selection of contractor
3	Financial issues
4	Top management support
5	Material
6	Labour
7	Equipment
8	Management factors
9	Execution
10	Selection of designer
11	Lack of communication
12	Systems (quality , safety)
13	Co-operation of parties
14	Design
15	Contract documents

Table (2.3)
The rank of the factors affect of quality by consultants

The Rank by Consultants	Quality Factors
4	Conformance to codes and standards
9	Selection of contractor
3	Financial issues
5	Top management support
1	Material
2	Labour
7	Equipment
6	Management factors
13	Execution
10	Selection of designer

15	Lack of communication
8	Systems (quality , safety)
11	Co-operation of parties
10	Design
14	Contract documents

The results from this study , show that the most important factor agreed by the contractors and consultants are: Conformance to codes and standards, Materials, Labours, Financial problems.

In another study, (Abdel-Razeq, 1998) identified the factors affecting quality. These factors can be summarized in the following sixteen dimensions:

1. Design and planning during the pre-construction phase.
2. Developing and improving quality assurance and control systems.
3. The financial level and standard of living of employees.
4. The accuracy of cost estimating.
5. Proper classification of contractors, consultants and projects.
6. Employees' consciousness.
7. Training for contractors, owners and consultants.
8. Encouraging ISO 9000.
9. Contractors' technical and managerial efficiency.
10. Maintenance systems during and after construction.
11. Utilization of resources.
12. Specialization in construction work.
13. Co-operation between construction industry and scientific organizations.
14. Participating and co-operating with advanced international organizations.
15. Defining responsibilities between project parties.
16. Encouraging innovation for simpler and more accurate work methods.

(Chan and Tam, 2000) stated that the generally perceived factors that influence quality performance can be grouped under the headings of client, project environment, project team leaders, project procedures and project management procedures.

The factors which have an effect on the quality of a construction building project were already identified by (Low and Goh, 1993 cited in Low and Peh, 1996). These are ranked below in their order of importance:

1. Poor workmanship by the contractors in completing the works results from low tender prices.
2. The drawings and specifications do not specify clearly the intentions of the designers. Discrepancies are found between different

consultant's drawings, which have resulted in poor co-ordination during construction.

3. The contractors pay more attention to complete the works on schedule and control the costs to within budget than to achieving quality in construction.
4. Poor coordination exists between the contractors and the subcontractors as well as the nominated subcontractors.
5. The designers do not consider the "build ability" problems in design. For example, the designers do not consider the use of special construction methods to achieve the tight tolerance caused by site conditions.
6. The contractors cannot plan and control the works. The contractors lack the skills to interpret the design and cannot provide the end products on site in accordance with the design and specifications.
7. The completion period fixed by the client and consultants is not realistic.
8. The design does not satisfy the relevant codes and standards. This has
9. resulted in a large amount of remedial work for the contractors and delay in the completion of projects.
10. The contractors do not know how to establish a quality system to control the works.
11. The materials chosen by the consultants do not satisfy the standards or the Building Control Authority.

2.11 Previous Studies

The Study by Priyanga and Ambika (2014), identified the factors which influence and enhance the process performance in India. The information collected during detailed literature survey and questionnaire was prepared and given to site engineers working in various construction companies in India. Statistical analysis was done for ranking and selection of major factors contributing the construction process performance .The result suggested that Frequent design changes, Project over time cost, Number of reworks , Shortage of site workers, Fluctuation in prices of materials equipments, Rework due to errors during construction, Shortages of materials, unexpected accidents, Site preparation time, Lack of motivation are the major factors which influencing in construction process performance.

The study by Callistus et al, (2014) identified and evaluated by ranking critical factors that influenced the quality performance of small scale contractors according to their relative importance and recommended measures to reduce its significance on project outcome. Sixty-nine (69) questionnaires were self-administered to professional staff including

architects, quantity surveyors, and engineers engaged by small scale contractors. The Relative Importance Index (RII) was used to rank factors for the analysis. The study find : fraudulent practices and kickbacks, lack of coordination between designers and contractors and, poor monitoring and feedback are ranked as the first three factors that affected the Quality performance of Small scale contractors and related to consultants. In addition, lack of training on quality for staff, lack of management leadership and lack of previous experience of contractor were also identified as factors related to contractors as the most critically ranked factors. It is therefore recommended that policy makers, researchers and practitioners look at improving the human resource base through continuous professional and skill development. Again monitoring systems should be improved at various district offices for the implementation of good construction procedure with the aim of ensuring quality practices. More importantly, design should be re-evaluated before the actual construction through pre-construction conference in order to do away with unnecessary design that will not ensure quality

The study by Patil et al (2011), examined the factors affecting on the Cost and Quality of Construction in India. Identified that 42 essential factors causing high construction costs for large construction projects. This paper find out the most influential factors in determining the cost and quality of construction are the price of labour, equipment, and material. Some of the reasons advanced for the project execution delays and subsequent overruns in time and cost are incompetent supervisors, lack of skills from the workers, rework, lack of tools and equipment, poor construction methods, poor communication, inaccurate drawings, stoppages because of work being rejected by consultants, political insecurity, tools/equipment breakdown, and harsh weather conditions.

The study by Palaniandy (2011), investigate the factors that affecting the quality deterioration in housing construction industry in Malaysia. A reliable survey instrument has been used for gathering the data's from the construction project workers such as Project Manager, Construction Manager, Engineer and Supervisor. The results indicate that construction staff's training, the role of Managers with the top management commitment is the significant variables explaining variability of operational performance. Furthermore, a series of analysis on training factors showed the importance of necessary and suitable training which relates to quality of the products in construction industry. The study also showed that training factors was influenced by other related factors such as the manager in charge and the management commitment towards the works. As the study was within Klang Valley, the implicating factors show a general result.

The study by Tan and Abdul-Rahman (2011), explores preliminarily the practices of quality management, management commitment in quality

management, and quality management implementation problems in construction projects in the context of Malaysian construction industry. This study applied semi-structured interview approach for twelve project management practitioners. This study conclude that Total quality management is not a common practice, ISO registration is mainly for marketing purpose, Leadership and participation of top management of construction companies in quality management need to be strengthened, The findings of this study indicate that the state of quality management in construction projects in Malaysia needs to be strengthened and there are problems in relation to quality management implementation that require attention and further research.
The study by Cao (2010), provided insight for the function and importance of quality control in china.this study was carried out in Jiangxi project company at the Third Chemical Engineering Construction Co. Ltd. (TCC). The result of the study was finding out the shortcoming of quality management of enterprise so as to improve the quality of product, work, and service, while strengthen the quality management system, and raise the overall level of quality management and gave some suggestions for the quality management and control of construction project, the first one, The mathematical methods can be used for quantitative control and management of project quality. It can make quality management more quantitative, objective and scientific. The second one, The review of the construction organization and workers should be strengthened, and the qualification management should be strict. The quality and technical operation of workforce should be improved through training, and the continuing education of technical staff should be encouraged.
The objective of paper by Enshassi et al (2009), is to identify the factors affecting the performance of local construction projects in Gaza Strip and their relative importance. The most important factors agreed by the owners, consultants, and contractors as the main factors affecting the performance of construction projects were: material prices, availability of resources as planned through project duration, average delay because of closures leading to materials shortage, availability of personnel with a high experience and qualifications, quality of equipment and raw materials in project and Leadership skills for project managers.
The study by Jha and Iyer (2006), evaluated various factors affecting the quality performance of construction projects in India and help to suggest possible remedial measures for improving the quality A preliminary survey identified 55 attributes responsible to impact quality performance of the projects using a questionnaire survey. A total of 112 completed responses were received from top Indian construction industry professionals. The result suggested that Project manager's competence, top management support and their competence, interaction between project participants,

owners' competence, and monitoring and feedback by project participants are the factors having positive contributions to achieving the desired quality level, while factors such as conflict among project participants, hostile socio-economic and climatic condition, ignorance and lack of knowledge, some project specific factors, and aggressive competition at the tender stage are found to adversely affect the quality performances of projects.

The study by Lombard (2006), provided insight into improving the quality of construction in South Africa by exploring the best practices for the quality management of engineering. the population of this study consisted of all individuals involved in engineering and the quality management aspects thereof on large capital projects within the construction industries of south Africa by making 13 interviewees with experts. The best practices were focusing revealing and calibrating client expectation, Briefing as process, design management, engineer in the field, Re-use of designs, involving supplier/constructor in design, using reputable suppliers, using incentives for engineers and creating an environment for prudent risk taking. This study showed more than 75% of interviewees being positive that these practices would improve the quality of engineering in construction.

The main objective of paper by Chini and Valdez (2003), determine whether ISO 9000 is an applicable tool for construction companies in the United States. ISO 9000, the series of quality management standards issued by the International Organization for Standardization, is being used by organizations involved in construction all over the world. A survey was distributed to a U.S. construction firms that have or have not received ISO 9000 Certification to determine their motivations for certification, the applicability of the standards inside construction organizations, and the barriers that limit the acceptance of ISO 9000 in U.S. construction firms. it was concluded that ISO 9000 is an appropriate and effective tool for construction firms in the United States, although several obstacles affect its implementation and acceptance among construction organizations.

The study by Darwish (2003), discussed the main factors affecting Design and Documentation Quality in Construction Industry in Saudi Arabia. A survey of 21 contractors, 19 consultants and 14 owners from the Eastern Province was performed. The survey included 39 different factors affecting Design and Documentation Quality and their level of importance. The severity of those factors were measured by the level of importance and were ranked according to the importance index for consultants, contractors, owners and a combination of all respondents. It was concluded that, last minute changes by client, Insufficient overall design time, Unstable client's requirements, Waiting for client decision and that Consultants tend to copy

and modify from their previous work to minimize time and cost, were the most important factors.
The study by Arditi et al (1999), conducted to investigate the differences in the perceptions of entry-level professionals and long-time practitioners with regard to process quality in building projects. The factors that affect process quality in the three phases (design, construction, and operation) of a building project's life cycle are identified and ranked by the respondents' perceived degree of importance. The questionnaire survey findings indicate that the perceptions of entry-level professionals and long-time practitioners are in agreement for most (74%) of the factors. Given the differences in the respondents' background, expectations, and experience, differences in perceptions are to be expected in the remaining 26% of the factors. Analyzing these differences helps in revising and improving existing training courses and academic programs.
The study by Arditi and Gunaydin (1998), identified the factors that affect process quality for building projects in Hong Kong. The generic factors that affect process quality are, management Commitment to continuous quality improvement, management leadership in promoting high process quality, quality training of all personnel, efficient teamwork to promote quality issues at the corporate level, and effective cooperation between parties taking part in the project. Industry specific factors are, Drawings and specifications that are consistent, designers and contractors that are selected on merit, communication practices between the parties that are effective and Inspection of quality on the construction site.
The study by Shively (1990), was carried out in Columbia to identify the specific actions that firms take to ensure quality in their organizations. This study presents the results of a comparison of at least 50 specific actions a consulting firm can take to ensure quality. From the study it is identified that the firms taking more care in the following areas for assuring the quality are, Goals and Objectives, Organizational Structure, Public Relations Practices, Office Environment and Technical Sources, professional and technical staff, Professional Development and Employee Advancement, project acceptance and proposal review, and loss prevention.

The survey is given to upper-level management of all firms and to

relatively new staff members in selected firms. The survey results contrast the firms' answers to prepared questions, as well as compare the answers of junior and senior members. Poor communication appears to be common within most of the firms.
A summary of the previous studies is shown in table (2.4)

Table (2.4)
Summary of previous studies

Author(s) and Year	Title of Study	Country/ Sample Size	Study Objective	Major Finding
Priyanga, Ambika, (2014)	Study on Factors Influencing Construction Process Performance	India	identify the factors which influence and enhance the process performance in India	Frequent design changes, Project over time cost, Number of reworks , Shortage of site workers, Fluctuation in prices of materials equipments, Rework due to errors during construction, Shortages of materials, unexpected accidents, Site preparation time, Lack of motivation
Callistus et al, (2014)	Factors Affecting Quality Performance of Construction Firms in Ghana: Evidence from Small–Scale Contractors	Ghanaian construction industry./ 69 questionnaire	Rank the factors that influenced the quality performance of small scale contractors according to their relative importance .	Fraudulent practices and kickbacks, lack of coordination between designers and contractors and, poor monitoring and feedback are ranked as the first three factors that affected the Quality performance of Small scale contractors
Patil, et al, (2011)	Factors Affecting the Cost and Quality of Construction	India	examined the Factors Affecting the Cost and Quality of Construction in India	The most influential factors in determining the cost and quality of construction are the price of labour, equipment, and material

Palaniandy, (2011)	A Study on Factors Affecting Quality Deterioration in Housing Construction Industry in Klang Valley	Malaysia/ Klang Valley	investigate the factors that affecting the quality deterioration in housing construction industry in Malaysia	Construction staff's training, the role of Managers with the top management commitment is the significant variables explaining variability of operational performance.

Author(s) and Year	**Title of Study**	**Country/ Sample Size**	**Study Objective**	**Major Finding**
Tan , Abdul-Rahman, (2011)	Study of Quality Management in Construction Projects	Malaysian construction industry/ 12 project management practitioners	The practices of quality management, management commitment in quality management, and quality management implementation problems in construction projects	The state of quality management in construction projects in Malaysia needs to be strengthened and there are problems in relation to quality management implementation that require attention
Cao, (2010)	Quality Control of Construction Projects	China- Third Chemical Engineering Construction Co. Ltd.	Find out the shortcoming of quality management of enterprise so as to improve the quality of product, work, and service.	Mathematical methods can be used for quantitative control and management of project quality, and review of the construction organization and workers should be strengthened, and the qualification management should be strict.

Enshassi et al, (2009)	Factors Affecting the performance of Construction Projects in the Gaza Strip	Gaza Strip	Identify the factors affecting the performance of local construction projects, and their relative importance	Material prices, availability of resources as planned through project duration, average delay because of closures leading to materials shortage, availability of personnel with a high experience and qualifications, quality of equipment and raw materials in project and Leadership skills for project managers.

Author(s) and Year	**Title of Study**	**Country/ Sample Size**	**Study Objective**	**Major Finding**
Jha ,Iyer, (2006)	Critical Factors Affecting Quality Performance in Construction Projects	India / 112 from top Indian construction industry professionals	Evaluated various factors affecting the quality performance of construction projects in India	The critical success factors obtained were: project manager's competence, top management's support, monitoring and feedback by project participants, interaction among project participants, and owners competence.
Lombard, (2006)	Managing the Quality of Engineering on the Large Construction Projects in the South African Context	South Africa/ 13 interviewees with experts	Exploring the best practices for the quality management of engineering	more than 75% of interviewees being positive the practices would improve the quality of engineering in construction.

Chini and Valdez (2003)	ISO 9000 and the U.S. Construction Industry	United state/ U.S. construction firms	Determine whether ISO 9000 is an applicable tool for construction companies in the United States	ISO 9000 is an appropriate and effective tool for construction firms in the United States.
Darwish, (2003)	Factors Affecting Design Documentation Quality in Construction Industry	Saudi Arabia /21 contractors, 19 consultants and 14 owners	discusses the main factors affecting Design and Documentation Quality in Construction Industry in Saudi Arabia.	last minute changes by client, Insufficient overall design time, Unstable client's requirements, Waiting for client decision and that Consultants tend to copy and modify from their previous work to minimize time and cost, were the most important factors

Author(s) and Year	Title of Study	Country/ Sample Size	Study Objective	Major Finding
Arditi , Gunaydin, (1999)	Perception of Process Quality in Building Projects	Chicago	investigate the differences in the perceptions of entry-level professionals and long-time practitioners with regard to process quality in building projects	The perceptions of entry-level professionals and long-time practitioners are in agreement for most (74%) of the factors.
Arditi , Gunaydin, (1998)	Factors that affect process Quality in the life cycle of building projects	Hong Kong/China	Identify the factors that affect process quality	management Commitment, management leadership, quality training of all personnel, efficient teamwork, and effective cooperation between parties.
Shively, (1990)	Survey of Quality-assurance procedures within	Columbia/ 50Consulting firm	Identify the specific actions that consulting firms take to ensure quality in their	Goals and Objectives, Organizational Structure, Public Relations Practices, Office Environment

consultant industry	organizations	and Technical Sources, professional and technical staff, Professional Development and Employee Advancement, project acceptance and proposal review, and loss prevention

It can be noted from these prior studies that most of them focused on identifying the factors which influence on construction process and the quality management and quality performance in construction projects in countries such as India, Ghana, Malaysia, China, United state, South Africa and Gaza strip, while none of these studies were conducted in Jordan. From other hand, none of the studies except (Patil 2011) have examined the factors affecting the quality of construction projects, and the rest of studies which talked about quality process , discussed the factors that affect process quality and investigate the difference in the perception regard to process quality in building projects only (Arditi Gunaydin, 1998; Arditi Gunaydin, 1999).

The current study characterized through its coverage of aspect not covered by previous studies, and these aspects as follows:

1. There is no studies looked at the this research in Jordan.
2. Development of theoretical framework to measure quality in Jordanian construction projects which has not been addressed or searched (by the extensive research of the current study).
3. Study the influence of factors on quality in construction projects, the few studies that have been mentioned, add to that evaluate the degree of influence from the owners and contractors perspectives.
4. Shed light on the views of the project owners and contractors with each in Jordan, There are no previous studies took into account this sample.
5. Developed the framework to measure the quality by applying the project management and quality management principles, and find the relative importance index for the main factors and dimension of the main factors, all these characteristics considered as the important addition to the study.

This chapter discussed the quality definitions by review the relevant literature studies. The factors affecting on quality, the role of quality management in construction projects, and the quality control and quality assurance all these topics introduced in this chapter.

Chapter Three
Design and Methodology

This thesis exist due to problem statement which quality challenges in construction projects, in order to achieve the objectives of the study by defining the quality factors, and the degree of influence of these factors to develop quality framework that will lead to deep understanding for the quality issue especially in construction sector, and to achieve the outstanding quality performance by how the quality factors relate to quality, these factors used as a base to measure the quality.

This chapter is concerned with research methodology. It includes research design, data collection methods, population and sample, questionnaire design, research type, and validity and reliability.

3.1 The Research Design

Research: is an investigation of finding solutions to scientific and social problems for new and useful information on a particular topic through objective and systematic analysis (Kothari, 1985).

Research design is the conceptual structure within which research would be conducted. The function of research design is to provide the collection of relevant information with minimal expenditure of effort, time and money (kumar,2005).

The nature of the research is quantitative. Creswell (1994) has given a very concise definition of quantitative research as a type of research that

is "explaining phenomena by collecting numerical data that are analyzed using mathematically based methods in particular statistics".
Shadish et al, (2001) described six phases embedded in each quantitative research design:

1. Introduction to a study that includes the purpose and research questions.
2. Theoretical perspectives or models.
3. Methodology that encompasses sampling and an evaluation of external validity, instrumentation that may include an evaluation of construct validity, experimental design that includes an evaluation of internal validity and data collection, and data analysis that includes an evaluation of statistical conclusion validity.
4. Reporting the results.
5. Conclusions and implications.

Quantitative research is interested in questions of how well, or how much, or to whom does the phenomenon in concern apply (Won, 2004). A sample survey was chosen as the research design for this study.

3.2 Population and Sample Selection

The term population is often used very broadly in research as natural, political or geographical collection of people, animals, plants or objects (Dowdy et al, 2004).

Two types of population were considered in this study the first population is the project owners, the second population is the contractors registered in the Jordanian Constructions Contractors Association, including engineers and managers at different positions.

Research sample refers to a subset of the population and comprises some members selected from it (Sekran, 2004). The researcher uses these to make conclusions about the population from which they are drawn which is the reason why the sample must be a very reliable representative.

The sample consists of 83 respondents from project owners and contractors. Table (3.1) shows the distribution of study sample.

Table (3.1)
Distribution of Study Sample

No. of Respondents	Sample
41	Contractors
42	Project owners
83	Total

3.3 Method of Collecting Data:

Applied and scientific researches, using different methods of data gathering for research purposes, the survey method is preferred by many researchers due to its various advantages, strengths and benefits.

Surveys can be conducted through:

1. Face-to-face interviews.
2. Telephone interviews.
3. Paper questionnaires.
4. Online questionnaires.
5. A combination of these methods

In this research the survey was conducted by combination of face to face interviews that were used to fill the questionnaire and clarifying it.

According to (Popper, 2005), the advantages of questionnaire are :

1. Practical.
2. Large amounts of information can be collected from a large number of people in a short period of time and in a relatively cost effective way.
3. Can be carried out by the researcher or by any number of people with limited affect to its validity and reliability.
4. The results of the questionnaires can usually be quickly and easily quantified by either a researcher or through the use of a software package.
5. Good statistical significance.

However, questionnaire has also some disadvantages:

1. Inadequate to understand some forms of information such: changes of emotions, behavior, feelings etc.
2. Lacks validity.
3. The respondent may be forgetful or not thinking within the full context of the situation.
4. People may read differently into each question and therefore reply based on their own interpretation of the question.
5. When developing the questionnaire, the researcher is making their own decisions and assumptions as to what is and is not important, therefore they may be missing something that is of importance.

This research is based on two sources to obtain the data:

First source is the secondary data:

1. Foreign books and references that deal with the same subject of this thesis.
2. Articles, magazines, previous research and dissertations of master and doctoral.
3. Websites through the internet.

Second source is the primary data:

Using the survey questionnaires as a main instrument to collect the information from the two parties of the study (owners and contractors).

3.4 Questionnaire Design

To meet the objectives of this research, application of quantitative methods and construction of questionnaire were set. A four-page questionnaire was developed as a research tool for this study.

Each questionnaire consists of three parts. Part one focuses on demographic and general information such as type of organization, experience, and position in organization. Part two explores the extent of awareness and concern of quality. Part three measure the influence degree of factors on quality of construction projects. The structure of the questionnaire is given in table (3.2).

Table (3.2)
The Structure of the Survey Questionnaire

Structure	Parts
Respondent information and company profile is comprised of seven questions. Four questions are closed-ended type with multiple choices, and the remaining questions are open-ended type.	Part one General Information
This section is comprised of seven questions. The questions are closed-ended type with multiple choice are used to assess the extent of awareness and concern of quality.	Part two Awareness and Concern of Quality
This section is comprised of fifty one	Part three

questions. All the questions are closed-ended to measure the influence degree of factors on quality of construction projects.	Measuring the influence degree of factors on quality of construction projects

The respondent's found the influence degree of factors on the quality of construction projects in section three, as this section contains dimensions correlated to their main factors, it will be used as a base for all statistical analysis approaches.

Respondents were asked to rate answer for 51 questions regarding of the influence degree of factors on quality of construction projects. We used an interval scale for the answers (large, medium, few and infective). The main objective in question design is to make the questions asked clear and concise. The language of the questionnaire is convenient with the local environment.

The questionnaire is located in appendix (I) of the research.

3.5 Factors Influencing on Quality of Construction Projects

Through the previous literature studies that were conducted in order to find out and identify the factors influencing on the quality of construction projects. They are categorized into twelve groups (main factors),each group is divided into dimensions:

1- Raw materials
   - 1.1- Availability of raw materials and high quality.
   - 1.2- Well storage of materials.
   - 1.3- A management system for raw materials and inventory.
   - 1.4- The use of local materials.
   - 1.5- The use of imported materials.

2- Equipment
   - 2.1- Provide equipment to suit project.
   - 2.2- Use proper required equipment .
   - 2.3- Equipment usable in all times.
   - 2.4- Maintenance of equipment are available and in good price.
   - 2.5- A system for equipment management.
   - 2.6- The existence of technicians and qualified drivers.

3- Contract
   - 3.1- Unified contract system.

3.2- Clarity of the conditions contained in the contract.

3.3- The distribution of tasks and responsibilities between parties involved in the contract.

4- Workers in the project

4.1- Experience of workers in the project.

4.2- Training of workers in the project.

4.3- Instruction and administrative system of management of the personnel.

4.4- A system of incentives for workers in the project.

4.5- Workers' salaries commensurate with experience.

5- The Manner of implementation of the project.

5.1- Ongoing follow-up supervision of the project.

5.2- Executive graphics processing in time.

5.3- Receipt of the executed works properly and timely.

5.4- A management system for follow-up of the project.

5.5- Using the latest means of implementation at all stages of implementation.

5.6- Reduce variation orders

6- Systems and software used for quality control and public safety.

6.1- Using modern and effective applications.

6.2- Public safety programs.

6.3- Application of control systems and quality management.

6.4- Application of software systems and cost control.

7- Design

7.1- Match specifications and codes of engineering.

7.2- Clearly, accurately and comprehensively designs.

7.3- Experience in designer.

7.4- Clearly the bill of quantities for specs and prices.

7.5- Speed completion of detailed design.

8- Project

8.1- The nature, type and complexity of the project.

8.2- The duration of the project.

8.3- The site and location of the project.

8.4- Ease access for project.

8.5- The cleanliness of project site.

9- Matching specifications and standards

9.1- The application and adherence to the standards and specifications contained in the plans, designs and quantities.

10- Cost

10.1- The cost of equipment.

10.2- The cost of raw materials and other materials needed for the project.

10.3- The cost of project personnel.

10.4- The cost of repairing the defects of the project

11- Training courses and meetings in the field of quality

11.1- Training courses for staff in the field of quality.

11.2- Meetings of the working group to emphasize the importance of quality.

12- Main contractor

12.1- The experience and class of classification of contracting company.

12.2- The amount of cash flow for the contractors

12.3- The Continuing cooperation between main contractor and sub-contractor.

12.4- The continuing cooperation between main contractor and supervision.

12.5- The continuing cooperation between owner and the main contractor .

3.6 Research Type

Qualitative research is characterized by the collection and analysis of textual data (surveys, interviews, focus groups, conversation analysis, observation, ethnographies ,Olds et al, 2005).

Qualitative research methods focus on discovering and understanding the experiences, perspectives, and the thoughts of participants that is, qualitative research explores meaning, purpose, or reality (Hiatt, 1986).

The aim of the quantitative research method is to test pre-determined hypotheses and produce generalizable results (Marshall, 1996)

Quantitative research is considered to be the more “scientific” approach to doing social science. The focus is on using specific definitions and carefully operational what particular concepts and variables mean. Qualitative research methods provide more emphasis on interpretation and providing consumers with complete views, looking at contexts, environmental immersions and a depth of understanding of concepts (Tewksbury,2009).

The purpose of quantitative studies is for the researcher to project his or her findings onto the larger population through an objective process. Data collected, often through surveys administered to a sample or subset of the entire population, allow the researcher to generalize or make inferences. Results are interpreted to determine the probability that the conclusions found among the sample can be replicated within the larger population. Conclusions are derived from data collected and measures of statistical analysis (Creswell, 2002; Thorne and Giesen, 2002).

Johnson and Turner (2003) have argued that the fundamental principle of mixed methods research is that multiple kinds of data should be collected with different strategies and methods in ways that reflect complementary strengths and non-overlapping weaknesses, allowing a mixed methods study to provide insights not possible when only qualitative or quantitative data are collected. Put another way, mixed methods research allows for the “opportunity to compensate for inherent method weaknesses, capitalize on inherent method strengths, and offset inevitable method biases” (Greene, 2007)

Caracelli and Greene (1997) identified three typical uses of a mixed methods study:

1. Testing the agreement of findings obtained from different measuring instruments.
2. Clarifying and building on the results of one method with another method.

3. Demonstrating how the results from one method can impact subsequent methods or inferences drawn from the results.

The main difference between two types is in flexibility (Mack et al,2005),while quantitative research poses the same questions to all participants and is the same order, qualitative research allows for interaction between researcher and participants.

3.7 Validity and Reliability

Validity refers to whether a study measures or examines what it claims to measure or examine. For determining validity of the questionnaire content credit was used.

To check the validity of the test was presented to a group of arbitrators of experienced and competent, as handed each of them a copy of the Instrument to express their opinion about the extent appropriate to the field of study, and the extent of belonging to the paragraphs that fall under it, and the clarity of the paragraphs, linguistic and scientific integrity, and add, delete or modify what they see fit. The researcher modified Instrument based on the notes of the arbitrators, and the most prominent of which reduce the number of questions and re-drafting some questions to be clearer (See Appendix III).

Reliability is the consistency of measurement, or the degree to which an instrument measures the same way each time it is used under the same condition with the same subjects.

To check the reliability of questionnaire, the pilot study was conducted.

The extraction of the internal consistency of the study tool coefficient, depending on the Cronbach's Alpha coefficient (Cronbach's Alpha) for each dimension of the study variables, where the result showed that, reliability coefficient values are high and show consistency and coherence between the paragraphs of the tool, the following table (3.3) shows the reliability coefficient values.

Table (3.3)
Cronbach's Alpha value of the coefficient of internal consistency for all study dimensions

Variables	Dimension	Paragraph	Cronbach's alpha
	Raw materials	1 - 5	.076
	Equipment	6 - 11	0.70
	Contract	12 - 14	0.75
	Workers in the project	19 - 15	0.73
The influence of	The manner of implementation of	20 - 25	0.74

factors on the quality in construction projects	the project Systems and software used for quality control and public safety	26 - 29	0.76
	Design	30 - 34	0.74
	The nature of the project	35 - 39	0.71
	Match specifications and standards	40	0.74
	Cost	41-44	0.72
	Training courses for staff in the field of quality	45-46	0.74
	main contractor	47-51	0.75

Data shown in Table (3.3) showed that the coefficients of the variable dimensions the impact of factors on the quality of construction projects, ranged between (0.71- 0.76), and considered such values are acceptable for the purposes of the present study.

Chapter Four
Data Analysis and Discussion of Results

This chapter covers the following areas: data analysis, discussion of results, theoretical framework and quality checklist.

4.1 Analysis Technique

The analysis technique in this study will be done through two statistical methods; the first method is the descriptive statistics used to summarize data reveal the existing patterns and easy interpretation of analysis results, it provides a general overview of the results. The second method is the inferential statistics method that is used to make comparison of result and test of statistical hypothesis.

4.2 The Descriptive Statistics Method

This method gives an idea of what is happening by using SPSS and excel software, the numerical presentation of data summary is the frequencies and percentages given below, which are related to the responses to individual questions in part one and part two, as well the mean and the standard deviation that describe the study's variable for part three. The tables that include percentages and frequencies as well as graphs in the form of the distribution frequencies diagram, also presented in the following.

4.2.1 Part One: General Information

1- Type of organization

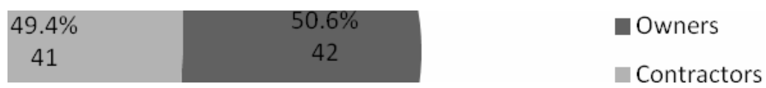


Figure (4.1):
Frequencies and Percentages According to Type of Organization

The Figure (4.1) above indicates that the number of contractors in the study sample was (41) and by (49.4%), while the total number of owners were (42) and by (50.6%). This convergence in number leads to increase the credibility of the study, so the number of the sample for each party will not effect on study results.

2- Job Title of Respondents

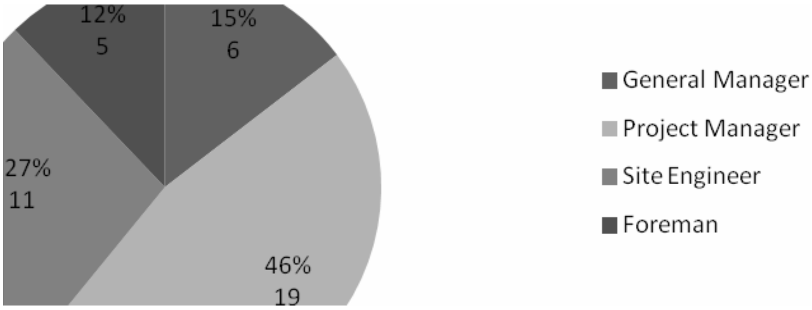


Figure (4.2)
Frequencies and Percentages According to Job Title of Respondents

The Figure (4.2) above shows the most of respondents which are: the project manager (46%) , the second of them is site engineer (27%), while (15%) is the general manager, the least number for the foreman (12%). This indicates the good interaction and cooperation by the project managers ,and also reflects the extent of their concern and interest in the subject of study, and supports the validity, credibility and conformity of the result of this questionnaire.

3- Demographic Variables:
The Educational level and Years of Experience

Table (4.1)
Frequencies and Percentages According to Demographic Variables

Percent	Frequencies	Variables	
3.6	3	High school	Educational level
9.6	8	Diploma	

71.1	59	Bachelor	
15.7	13	Graduate studies	
100	**83**	**Total**	
19.3	16	Less than 15	Years of Experience
35	29	15-20	
24.1	20	21-26	
21.6	18	More than 26	
100	**83**	**Total**	

Notes from the table (4.1) above, respect to the educational level variable, the highest percentage was in favor of individuals with a bachelor's degree in terms of (71.1%), followed by individuals with the proportion of the postgraduate degree as was (15.7%), followed by individuals with the proportion of the degree diploma, which amounted to (9.6%), the proportion of individual with secondary school came final , which amounted to (3.6%). This result is attributed to the nature of the work carried out by owners and contractors, which need skills and capabilities that require the presence of an appropriate scientific qualification.

As for the years of experience variable notes, a majority of individuals have experience between (15 to 20 years) by (35%) this making us rely on their answers, followed by individuals who has experience between (21 to 26 years) by (24.1%), then the individuals who has experience (more than 26 years) by (21.6%) and, finally, individuals who has experience (less than 15 years) by (19.3%), due to the fact that the majority of individuals obtain efficiency and expertise that are appropriate to the nature of the work of construction projects in Jordan.

This demonstrates that this study is comprehensive for all levels in education and experience.

4- Classification of Contracting Companies

Table 4.2
Frequencies and Percentages According to Classification of Contracting Companies

Percent	Frequencies	Classification
48.8	20	First Class
26.8	11	Second Class

14.6	6	Third Class
7.4	3	Fourth Class
2.4	1	Others
100	**41**	**Total**

The table (4.2) above shows that the total number of contracting companies is 41. It is noted that most of them are classified at first class by (48.8%), following the second class is (26.8%), while fourth class (7.4%), since the majority of participants in questionnaire of the construction companies are classified as first class and regarding for their own experiences and possibilities this reflects the confidence and accuracy of this study.

5- Number of Projects Implemented in the Last Five Years

Table 4.3
Frequencies and Percentages of Respondents According to Number of Projects Implemented in the Last Five Years

Percent	Frequencies	Answers
26.5	22	Less than 15
48.2	40	15 - 24
21.7	18	25 - 34
3.6	3	More than 34
100	**83**	**Total**

As shown in table (4.3) above, respect to the number of projects implemented in the last five years , the highest percentage was in favor for the answer (15 – 24) projects in terms of (48.2%), followed by respondents with the proportion of the (less than 15) projects as was (26.5%), followed by respondents with the proportion of the (25 – 34) projects, which amounted to (21.7%), Finally came the proportion of respondents with (more than 34) projects, which amounted to (3.6%). This result is an indicator that respondents have a good experience and ability to identify the factors influencing on the quality.

6-Type of Implemented Projects

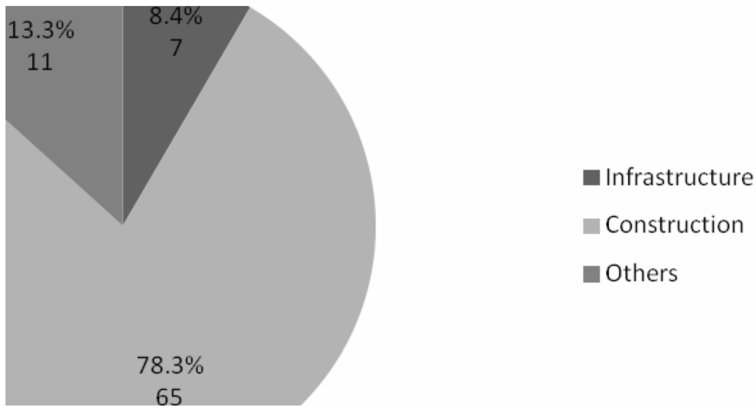


Figure (4.3)
Frequencies and Percentages According to Type of Implemented Projects

The figure (4.3) shows that (78.3%) of the surveyed are dealing with construction projects, (8.4%) deals with infrastructure projects, while (13.3%) deals with other projects. These percentages indicated by the study contains sufficient information from various types of projects, it is noted that the highest percentage of projects are construction ones, because of the nature and the diversity of construction projects such as; "schools, colleges, hospitals.".

4.3 Part Two: Awareness and Concern of Quality

1- The Attention Rate of the Quality

Table 4.4
Frequencies and Percentages According to Attention Rate of the Quality

Percent	Frequencies	Average
48.2	40	High
39.8	33	Mid rate
12.0	10	Low rate
0	0	Never
100	**83**	**Total**

The table (4.4) above, shows that 48.2% of respondents have good awareness of quality issue and their answers were high, of those 40 respondents, (39.8%) of respondents have mid rate awareness of quality issue, (12%) of them have low rate. This explains that the quality issue has become an important and necessary issue and emphasizes the importance of this study**.**

2- The employees involved of quality

Table 4.5
Frequencies and Percentages According to The Employees involved of Quality

Percent	Frequencies	No. of Employees
10.8	9	No Employees
5.1	5	1
35.9	29	2 to 4
48.2	40	More than 4
100	**83**	**Total**

As shown in table (4.5), most of organization have more than 4 employees (48.2%) that involved in quality, (35.9%) of them have 2 to 4 employees, while (5.1%) have only 1 employee. This indicates that the organizations have a good attention to the quality issue.

3- Applied a system for Improving Quality

Table 4.6
Frequencies and Percentages According to Applied a system for Improving Quality

Percent	Frequencies	Answers

18.0	15	No
12.0	10	Recently
45.9	38	Yes, Long time
24.1	20	Under Consideration
100	**83**	**Total**

As shown in table (4.6), it is clear that (45.9%) of respondents have improvement in quality system for a long time, (24.1%) of respondents their quality system is under consideration, while (12%) of respondents answered has implemented quality system improvement recently. This indicates that quality improvement has become a priority for owners and contracting companies.

4- Having ISO Certificate

Table 4.7
Frequencies and Percentages of Contracting Companies Having ISO Certificate

Percent	Frequencies	Answers
22	9	Yes
78	32	No
100	**41**	**Total**

The Table (4.7) and Figure (4.10) above show that most of the contracting companies don't have ISO certificate with proportion (78%), and only (22%) of the contracting companies own it.

This results regarding to several obstacles that affect its implementation and acceptance among construction, also the high cost of getting ISO certificate.

5- The concept of Quality Best Suited

Table 4.8
Frequencies and Percentages According to the Best Suited Concept of Quality

Percent	Frequencies	Concept

72.4	60	Conformance to requirements and specifications
6.0	5	The customer satisfaction achievement
9.6	8	Reduction in defects
12.0	10	Reduction in total cost
100	**83**	**Total**

The results as shown in table (4.8) above, with respect to the quality concept, notes that majority of individuals who answered this question, the quality concept is conformance to requirements and specifications with proportion of (72.4%), followed by individuals answered the quality concept gave reduction in total cost with proportion of (12%), then the individuals who answered reduction in defects were (9.6%), finally individuals who answered the quality concept is the customer satisfaction achievement with (6%)proportion, due to the fact that all these concepts for quality but in this results found the most familiar concept for quality among contractors and owners in Jordan was conformance to requirements and specifications.

6- Attention in to Quality, Raises the Total Cost of Quality

Table 4.9
Frequencies and Percentages of Respondents According to the Attention to Quality Raises the Total Cost

Percent	Frequencies	Answers
63.9	53	Yes
36.1	30	No
100	**83**	**Total**

As obvious in table (4.9) above, regarded to question number six ,if the attention to quality raises the total cost , it is clear that the highest percentage was in favor for the answer (Yes) in terms of (63.9%), since the (36.1%) of sample study choose the answer (No),this is related to economic changes and rising prices.

7- The Role of Project Management to Ensure Quality in Construction Projects

Table 4.10

Frequencies and Percentages of Respondents According to the Role of Project Management to Ensure Quality in Construction Projects

Percent	Frequencies	Answers
90.4	75	Yes
9.6	8	No
100	**83**	**Total**

The table (4.10) above, shows that just 8 of respondent out of 83 answered (No) for the question with respect to the role of project management in playing a fundamental role in ensuring quality in construction projects with proportion of (9.6%), to some extent it is a very small percentage, while 75 respondents answered (Yes) by (90.4%), it is the vast majority.

This finding proves that there must be an active role by the project management in achieving the required level of quality in construction projects.

4.4 Part Three : Influence of Factors on Quality of Construction Projects

Table (4.11)

Arithmetic Mean for Each (project owner and contractor) Answers

Total		**Contractor**		**Project Owner**		**Dimension**
SD	**Mean**	**SD**	**Mean**	**SD**	**Mean**	

0.87	3.45	0.89	3.44	0.85	3.46	Raw materials
0.85	3.43	0.84	3.45	0.87	3.41	Equipment
0.91	3.40	0.93	3.39	0.89	3.42	Contract
0.87	3.39	0.85	3.38	0.86	3.40	Workers in the project
0.86	3.34	0.80	3.35	0.90	3.33	The manner of implementation of the project
0.94	3.30	0.85	3.29	0.96	3.31	Systems and software used for quality control and public safety
1.17	3.27	0.87	3.26	0.88	3.28	Design
0.93	2.97	0.85	2.99	0.97	2.95	The nature of project
0.99	2.95	0.94	2.94	0.91	2.96	Match specifications and standards
1.13	2.89	0.92	2.91	0.99	2.88	Cost
0.59	2.87	0.97	2.90	0.99	2.84	Training courses and meeting in the field of quality
0.94	2.85	0.95	2.84	1.01	2.86	The main contractor
0.87	3.175	0.86	3.176	0.89	3.173	**Total**

Table (4.11) above showed that, the arithmetic average of all the dimensions of the study from the standpoint of Contractors was (3.175),

which is high and indicated the extent of the impact of these dimensions on quality level in construction projects. While the arithmetic mean of all the dimensions of the study from the perspective of project owners (3.173), It indicates the extent of the influence of these factors on quality level in construction projects from project owners' perspective, and reveals that project owners and contractors, look at the influence of these factors at the same level, which means there is no difference in their views, and attributable this result to that, both parties always seek to achieve the highest level of quality in construction projects, so they know and aware of all the factors influencing the level of quality.

Dimensions for the First Factor (Raw Materials):

Table (4.12)
Arithmetic Mean and Standard Deviation for Raw Materials Dimensions

Standard Deviation	Arithmetic Mean	Dimension
0.87	3.54	Availability of raw materials and high quality
0.85	3.50	Storage of materials well
0.91	3.45	A management system for raw materials and inventory
0.87	3.40	The use of local materials
0.86	3.37	The use of imported materials
0.87	**3.45**	**Total**

As shown in Table (4.12) above:

1. The overall average for the perceptions of the study sample of raw materials came highly in degree, and reached a mean of (3.45) and (0.87) standard deviation.
2. Dimension number (1) "Availability of raw materials and high quality" ranked first with mean of (3.54) and standard deviation (0.87), this dimension has high influence degree on the quality of Jordanian construction projects from the point of view of owners and contractors with respect to raw materials factor .

3. The dimension that got a second order of the influence degree is well storage of materials with mean of (3.50) and standard deviation of (.85).
4. A management system for raw materials, inventory and the use of local materials are getting a closer mean in terms of their influence degree for quality of Jordanian construction projects.
5. While the use of imported materials ranked last among the dimension of this factor, with mean of (3.37), this reflects that the degree of approval is also high.

Dimensions for the Second Factor (Equipment):

Table (4.13)
Arithmetic Mean and Standard Deviation for Equipment Dimensions

standard deviation	Arithmetic mean	Dimension
0.95	3.48	provide equipments to suit project
0.86	3.46	Use proper equipment required
0.88	3.43	equipment useable in all time
0.93	3.42	Maintenance of equipment are available and in good price
0.90	3.41	A system for equipment management
0.99	3.38	The existence of technicians and qualified drivers
0.85	**3.43**	**Total**

As clearly illustrated in table (4.13) above:

1. The overall average for the perceptions of the study sample of equipment came with a high degree, and reached a mean of (3.43) and standard deviation of (0.85).
2. The Dimension number (1) " provide equipments to suit project "ranked first with mean of (3.48) and standard deviation of (0.95), this dimension has high influence degree on the quality of Jordanian construction projects from the point of view of owners and contractors with respect to equipment factor .

3. The dimension which got a second order of the influence degree is the "use of proper equipment required", with mean of (3.46) and standard deviation of (0.86).
4. The useable equipment in all time, maintenance of equipment are available and in good price , and a system for equipment management are getting a closer mean in terms of their influence degree for quality of Jordanian construction projects.
5. While the existence of technicians and qualified drivers ranked last among the dimension of this factor, with mean of (3.38) and a standard deviation of (0.99) which reflects the degree of approval is also high.

The Dimensions for the Third Factor (Contract):

Table (4.14)
Arithmetic Mean and Standard Deviation for Contract Dimensions

standard deviation	Arithmetic mean	Dimension
.97	3.43	Unified contract system
1.03	3.39	Clarity of the conditions contained in the contract
1.07	3.38	The distribution of tasks and responsibilities between parties involved in the contract
0.91	**3.40**	**Total**

As noted in table (4.14) above:
1. This factor has also a significant influence on quality of construction projects in Jordan, and it showed that the overall average and standard deviation value, which is equal to (3.40) and (0.91) respectively.
2. Owners and contractors have found that the use of unified contract system will affect more than other dimension pertaining to the contract factor.

3. The dimension which got a second order of the influence degree is the clarity of the conditions contained in the contract with mean of (3.39) and a standard deviation of (1.03).
4. Likewise the third dimension " The distribution of tasks and responsibilities between parties involved in the contract " got the arithmetic mean and standard deviation values(3.38) , (1.07) respectively .Since it has converged values with the mean and standard deviation for second dimension " Clarity of the conditions contained in the contract " it indicates that these dimensions have the same influence degree on quality in Jordanian construction projects.

The Dimensions for the Fourth Factor (Workers in the project):

Table (4.15)
Arithmetic Mean and Standard Deviation for Workers in the project Dimensions

standard deviation	Arithmetic mean	Dimension
0.95	3.42	Experience of workers in the project
0.86	3.40	Training of workers in the project
0.88	3.39	Instruction and administrative system of management of the personnel
0.93	3.37	A system of incentives for workers in the project
0.90	3.37	Workers' salaries commensurate with experience
0.87	**3.39**	**Total**

As seen in table (4.15) above:
1. It was expected that most of Jordanian owners and contractors, consider that workers in the project has a significant influence on construction quality.
2. The study sample arranged these dimensions depending on their point of view as follows:
   Experience of workers in the project, followed by training of workers in the project, then instruction and administrative system of

management of the personnel, and a system of incentives for workers in the project, finally, workers' salaries commensurate with experience.

The Dimensions for the Fifth Factor (The Manner of Implementation of the Project):

Table (4.16)
Arithmetic Mean and Standard Deviation for The Manner of Implementation of the Project Dimensions

standard deviation	Arithmetic mean	Dimension
0.92	3.43	Ongoing follow-up supervision of the project
0.89	3.42	Executive graphics processing in time
0.84	3.40	Receipt of the executed works properly and timely
0.91	3.35	A management system for follow-up of the project
0.90	3.31	Using the latest means of implementation at all stages of implementation
0.94	3.30	Reduce variation orders
0.86	**3.34**	**Total**

The table (4.16) above illustrates the following:

1. The overall average for the perceptions of the study sample of "The manner of implementation of the project" came highly in degree, and reached a mean of (3.34) and a standard deviation of (0.86).
2. The opinion of Jordanian owners and contractors were above the neutral level, regarding the influence degree for the manner of

implementation of the project, which means that we can consider it important to take these dimensions into consideration.

3. Dimension number (1) "Ongoing follow-up supervision of the project" ranked first with a mean of (3.43) and standard deviation of (0.92), this dimension has high impact degree on the quality of Jordanian construction projects from the point of view of owners and contractors with respect to the implementation method.
4. While reduced variation orders ranked last among the dimension of this factor, with a mean of (3.30), which reflects that the degree of approval is also high.
5. While Reduce variation orders ranked last among the dimension of this factor, with mean (3.30), which reflects the degree of approval is also high.

The Dimensions for the Sixth Factor (Systems and Software Used for Quality Control and Public Safety):

Table (4.17)
Arithmetic Mean and Standard Deviation for Systems and Software Used for Quality Control and Public Safety Dimensions

standard deviation	Arithmetic mean	Dimension
0.85	3.35	Using modern and effective applications
0.94	3.32	Public safety programs
0.88	3.29	Application of control systems and quality management
0.93	3.27	Application software, systems cost control
0.94	**3.30**	**Total**

Table (4.17) above showed that:

1. All the arithmetic mean values for these dimensions gave an indication of the importance that all of these dimensions will affect construction quality.

2. The arithmetic average of all the dimensions with respect to use system and software in projects ,from the standpoint of owners and contractors was (3.30) and with a standard deviation of (0.94).

3. The dimension number (1) " Using modern and effective applications" got the highest mean value which amounted (3.35),this means that this dimension has more influence than other dimensions.

The Dimensions for the Seventh Factor (Design):

Table (4.18)
Arithmetic Mean and Standard Deviation for Design Dimensions

standard deviation	Arithmetic mean	Dimension
0.89	3.32	Match specifications and codes of engineering
0.94	3.29	Clearly, accurately and comprehensively designs
0.88	3.26	Experience in designer
1.02	3.25	Clearly the bill of quantities for specs and prices
1.06	3.23	Speed completion of detailed design
1.17	**3.27**	**Total**

As shown in table (4.18) above:

1. The arithmetic mean values ranging between 3.32 to 3.23 which is high and indicated the extent of the influence of these dimensions on quality level in construction projects.
2. While the arithmetic mean of all the dimensions of the study from the perspective of study sample was (3.27), which is also a high value ,indicates the extent of the influence of these factors on the quality level in construction projects.

The Dimensions for the Eighth Factor (The Nature of Project):

Table (4.19)
Arithmetic Mean and Standard Deviation for the Nature of Project Dimensions

standard deviation	Arithmetic mean	Dimension
0.87	3.02	The nature, type and complexity of the project
0.90	2.99	The duration of the project
0.93	2.97	The site and location of the project
1.05	2.94	Ease access for to project
0.99	2.93	The Cleanliness of project site
0.93	**2.97**	**Total**

Noted from table (4.19) above:

1. The overall average for the perceptions of the study sample of design came above the neutral level, and reached a mean of (2.97) and a standard deviation of (0.93).
2. It is clear through the arithmetic mean values of these dimensions that they have an influence on quality of construction projects from the point of view of owners and contractors in Jordan, but not to the same degree of influence of the previous factors, and the reason was that the majority proportions of the study sample were owners.

The Dimensions for the Ninth Factor (Match Specifications and Standards):

Table (4.20)
Arithmetic Mean and Standard Deviation for Match Specifications and Standards Dimensions

standard deviation	Arithmetic mean	Dimension
0.99	2.95	The application and adherence to the standards and specifications contained in the plans, designs and quantities
0.99	**2.95**	**Total**

As clearly illustrated in table (4.20) above:

Dimension of "The application and adherence to the standards and specifications contained in the plans, designs and quantities" got the arithmetic mean value which amounted (2.95) and a standard deviation which amounted (0.99).It is considerable for owners and contractors in Jordan.

The Dimensions for the Tenth Factor (Cost):

Table (4.21)
Arithmetic Mean and Standard Deviation for Cost Dimensions

standard deviation	Arithmetic mean	Dimension
0.92	2.93	The cost of equipment
0.99	2.91	The cost of raw materials and other materials needed for the project
1.02	2.89	The cost of project personnel
1.12	2.83	The cost of repairing the defects of the project
1.13	**2.89**	**Total**

As seen in table (4.21) above:

1. All the arithmetic mean values for these dimensions gave an indication of the importance that all of these dimensions will influence on construction quality.
2. The overall average for the perceptions of the study sample of cost factor, reached a mean of (2.89) it is not a high degree compared with other factors, but still above the neutral level.
3. The dimension number (1) "cost of equipment" ranked first with a mean of (2.93) and a standard deviation of (0.92).
4. The dimension which got a second order of the influence degree is the cost of materials with a mean of (2.91) and a standard deviation of (0.99).
5. The dimensions in the third order and fourth order respectively were; cost of project personnel and the cost of repairing the defects of the project.

The Dimensions for the Eleventh Factor (Training Courses and Meetings in the Field of Quality):

Table (4.22)

Arithmetic Mean and Standard Deviation for Meetings and Training Dimensions

standard deviation	Arithmetic mean	Dimension
0.87	2.89	Training courses for staff in the field of quality
0.82	2.85	Meetings of the working group to emphasize the importance of quality
0.59	**2.87**	**Total**

As noted in table (4.22) above:

1. The arithmetic mean values for these dimensions is not much different from two the previous factors, which the overall average mean and standard deviation reached to (2.87) , (0.59) respectively.

   The owners and contractors believe that the first dimension "training courses for staff in the field of quality", has greater influence degree on construction quality in Jordan than the second dimension "meetings of the working group to emphasize the importance of quality ".

The Dimensions for the Twelfth Factor (Main Contractor):

Table (4.23)

Arithmetic Mean and Standard Deviation for Main Contractor Dimensions

standard deviation	Arithmetic mean	Dimension
0.87	2.88	The experience and class of classification of contractor company
0.82	2.87	The amount of cash flow for the contractors
0.87	2.85	The Continuing cooperation between main contractor and sub contractor

0.82	2.84	The Continuing cooperation between main contractor and supervision
0.87	2.81	The Continuing cooperation between main contractor and owner
0.94	**2.85**	**Total**

The table (4.23) above shows the following:

1. All the arithmetic mean values for these dimensions gave an indication of the importance that all of these dimensions will influence on construction quality.

2. According to the arithmetic mean values ,the owners and contractors ranked the dimensions with regard to their influence degree on the construction quality as the following:
   First one is the experience and class of classification of contracting company.
   Second one is the amount of cash flow for the contractors.
   Third one is the continuing cooperation between main contractor and sub-contractor.
   Fourth one is the continuing cooperation between main contractor and supervision
   And the last one is the continuing cooperation between owner and main contractor.

After identifying the factors influencing on quality in construction projects, the Relative Importance Index method (RII) was used to determine owners and contractors perception of the relative importance of the identified quality factors. Using this formula, the major factors influencing quality was identified. The RII was computed as:

$$RII = \frac{\Sigma W}{A_N}$$

Where,
RII : Relative Importance Index
W : Weighting given to each factor by the respondents (ranging from 1 to 4)
A : Highest weight
N : Total number of respondents

The relative importance index has been calculated for the main factors and then the dimensions were arranged as shown in the tables below:

Table (4.24)

Relative Importance Index and Rank for Dimensions of Raw Material

Rank	RII	Dimension	No.
1	0.885	Availability of raw materials and high quality	1
2	0.875	Storage of materials well	2
3	0.863	A management system for raw materials and inventory	3
5	0.850	The use of local materials	4
4	0.843	The use of imported materials	5

Table 4.24 above shows the order of owners and contractors of raw materials dimensions, where the dimension "Availability of raw materials and high quality" is the first order of importance according to their point of view, and that shows the need for raw materials in the project, and its high quality has significant influence on quality in the enterprise. While the dimension" use of local materials", became fifth respectively, and this shows that there is no significant relationship between use of local materials and quality in construction projects.

Table (4.25)

Relative Importance Index and Rank for Dimensions of Equipment

Rank	RII	Dimension	No.
1	0.87	Provide equipments to suit project	1
2	0.865	Use proper equipment required	2
3	0.858	equipment useable in all time	3
4	0.855	Maintenance of equipment are available and in good price	4
5	0.853	A system for equipment management	5
6	0.845	The existence of technicians and qualified drivers	6

The results shown in table 4.25 and by relative importance index values where higher value of 0.87 for the first dimension, and this shows the importance of the availability of equipment that is suitable for the project has high impact on quality. The relative importance indicator values for third, fourth and fifth dimensions were very close, ranged (0.853-0.858) reflecting the convergence of its impact on quality, as for the last dimension which is about the existence of technicians and qualified drivers for the equipment, the importance relative indicator values were low compared to other dimensions and that's an indication for its lack of impact on quality.

Table (4.26)
Relative Importance Index and Rank for Dimensions of Contract

Rank	RII	Dimension	No.
1	0.858	Unified contract system	1
2	0.848	Clarity of the conditions contained in the contract	2
3	0.845	The distribution of tasks and responsibilities between parties involved in the contract	3

As shown in table 4.26 the use of unified contract system has high importance and came in the first place because it includes both parties, the owner and the contractor and maintains their rights, it is an essential step to avoid spam in project implementation, and reduce the problems occurring during the period of the contract between the parties. As for the clarity of the terms in the contract and the distribution of tasks and responsibilities between the parties involved in the contract, were ranked second and third respectively in terms of the degree of importance.

Table (4.27)
Relative Importance Index and Rank for Dimensions of Workers in the Project

Rank	RII	Dimension	No.
1	0.855	Experience of workers in the project	1
2	0.85	Training of workers in the project	2
3	0.848	Instruction and administrative system of management of the personnel	3
4	0.843	A system of incentives for workers in the project	4
5	0.842	Workers' salaries commensurate with experience	5

Table 4.27 above shows that the dimensions of the project workers are no less important than the previous dimensions ranging from the relative importance index values (0.842-0.855).The dimension "Experience of workers in the project" was the most important of these dimensions according to owners and contractors, that’s because the long experience of the staff will be reflected positively on quality. While the proportion between the salaries of employees and expertise became less and so has less effect.

Table (4.28)
Relative Importance Index and Rank for Dimensions of the Manner of Implementation of the Project

Rank	RII	Dimension	No.
1	0.858	Ongoing follow-up supervision of the project	1
2	0.855	Executive graphics processing in time	2
3	0.85	Receipt of the executed works properly and timely	3
4	0.838	A management system for follow-up of the project	4

5	0.828	Using the latest means of implementation at all stages of implementation	5
6	0.825	Reduce variation orders	6

As noted in table 4.28 related to the manner of implementation of the project. , owners and contractors gave "follow-up and ongoing supervision of the project "the top importance through the relative importance index value which equals to (0.858),and it is contiguous with the relative importance index value for the second and third dimension which equals 0.855, 0.85, respectively. In addition to the fifth and sixth dimensions which has relative importance index values that were close to them, giving an indication of the convergence degree of their influence on quality.

Table (4.29)
Relative Importance Index and Rank for Dimensions of System and Software

Rank	RII	Dimension	No.
1	0.838	Using modern and effective applications	1
2	0.83	Public safety programs	2
3	0.823	Application of control systems and quality management	3
4	0.818	Application software, systems cost control	4

Table 4.29 above shows the order of owners and contractors for the dimension "Systems and Software Used for Quality Control and Public Safety" ,where the dimension of " Using modern and effective applications" got the first order of importance according to their point of view and shows the need for these applications because of their significant impact on quality in the enterprise. While" Application software, systems cost control", dimension became fourth respectively.

Table (4.30)
Relative Importance Index and Rank for Dimensions of Design

Rank	RII	Dimension	No.
1	0.83	Match specifications and codes of engineering	1
2	0.823	Clearly, accurately and comprehensively designs	2
3	0.815	Experience in designer	3
4	0.813	Clearly the bill of quantities for specs and prices	4
5	0.808	Speed completion of detailed design	5

The results shown in table 4.30 by relative importance index values, where the highest value of 0.83 for the first dimension. The relative importance index values for the third and fourth dimensions were very close in range (0.813-0.815) reflecting the convergence of its influence on quality.

Table (4.31)
Relative Importance Index and Rank for Dimensions of Nature of the Project

Rank	RII	Dimension	No.
1	0.755	The nature, type and complexity of the project	1
2	0.748	The duration of the project	2
3	0.743	The site and location of the project	3
4	0.735	Ease access for to project	4
5	0.733	The Cleanliness of project site	5

As shown in table 4.31 above , the dimensions related to the nature of the project were ranked in its importance according to the contractors and owners point of view "The nature, type and complexity of the project" became first place," The duration of the project" became in second place," The site and location of the project" in third place,"

Ease access for project" in fourth place, as for" The Cleanliness of project site" became in the fifth and last place.

Table (4.32)
Relative Importance Index and Rank for Dimensions of Match Specifications and Standards

Rank	RII	Dimension	No.
1	0.738	The application and adherence to the standards and specifications contained in the plans, designs and quantities	1

Table 4.32 above shows that the relative importance index value for matching standards and specifications equals to 0.738 which is an average value compared to other factors.

Table (4.33)
Relative Importance Index and Rank for Dimensions of Cost

Rank	RII	Dimension	No.
1	0.733	The cost of equipment	1
2	0.728	The cost of raw materials and other materials needed for the project	2
3	0.723	The cost of project personnel	3
4	0.708	The cost of repairing the defects of the project	4

As noted in table 4.33 related to the cost. , the owners and contractors gave "The cost of equipment" top importance through the relative importance index value which equals to (0.733) while the relative importance index value of the last dimension is equal to (0.708).

Table (4.34)
Relative Importance Index and Rank for Dimensions of Training Courses

Rank	RII	Dimension	No.
1	0.723	Training courses for staff in the field of quality	1
2	0.713	Meetings of the working group to emphasize the importance of quality	2

The results shown in table 4.34 demonstrate the need to focus on training courses for staff and enhance their skills in the field of quality.

Table (4.35)
Relative Importance Index and Rank for Dimensions of Main Contractor

Rank	RII	Dimension	No.
1	0.72	The experience and class of classification of contractor company	1
2	0.718	The amount of cash flow for the contractors	2
3	0.713	The Continuing cooperation between main contractor and sub contractor	3
4	0.71	The Continuing cooperation between main contractor and supervision	4
5	0.703	The Continuing cooperation between main contractor and owner	5

Table 4.35 illustrates the order of owners and contractors of dimensions associated with the main contractor, where the contractor and the degree of experience rating got first ,followed by the cash flow for the contractor, as for the cooperation of the main contractor with the sub-contractor it became in third place, and cooperation between contractor with supervision ranked fourth and collaboration of the contractor with the owner became in last place.

There are some correlation between the owners and contractors in case of quality influencing factors. The tables that contain the ranking of owners and contractors is given below:

Table (4.36)

Summary of Relative Importance Index and Rank of Quality Factors by Owner

Rank	RII	Quality Factors	No.
1	0.865	Raw materials	1
3	0.853	Equipment	2
2	0.855	Contract	3
4	0.850	Workers in the project	4
5	0.833	The manner of implementation of the project	5
6	0.828	Systems and software used for quality control and public safety	6
7	0.820	Design	7
9	0.738	The nature of project	8
8	0.740	Match specifications and standards	9
10	0.720	Cost	10
12	0.710	Training courses and meeting in the field of quality	11
11	0.715	The main contractor	12

Table (4.37)
Summary of Relative Importance Index and Rank of Quality Factors by Contractors

Rank	RII	Quality Factors	No.
2	0.860	Raw materials	1
1	0.863	Equipment	2
3	0.848	Contract	3
4	0.845	Workers in the project	4
5	0.838	The manner of implementation of the project	5
6	0.823	Systems and software used for quality control and public safety	6
7	0.815	Design	7
8	0.748	The nature of project	8
9	0.735	Match specifications and standards	9
10	0.728	Cost	10
11	0.725	Training courses and meeting in the field of quality	11
12	0.710	The main contractor	12

Tables (4.36) and (4.37) illustrate the top significant factors influencing the quality of construction projects.

According to contractors' point of view the equipment, raw material, contract and Workers in the project strongly influence quality in construction project.

The owners support the contractors in these views, observing that the owners and contractors approximately have the same opinion towards ranking most of quality factors.

This result is attributable to the owners and contractors care about the same degree of quality of construction works, as they work under the same

conditions. In addition, quality is everyone's responsibility and lead to the interests of all parties in construction projects.

4.5 Hypothesis Testing

For all the hypotheses of the study below hypothesis test was used at 95% confidence interval.

First Hypothesis

The research hypothesis:

H_o :There is a significance difference in perception between project owners and contractors regarded to factors influencing on quality.

The null hypothesis:

H_a : There is no difference in perception between contracting and project owners regarded to factors influencing on quality.

Statement of hypothesis testing:

Note from the below table (4.38) and table (4.39) that the level of importance of this hypothesis was high, averaging arithmetic (3.17), as seen R and R squared values equal 0.089 and 0.008 respectively, It should be noted that R-squared values range from 0 to 1. the test value (F) is equal to (1.693) the value of the probability (0.195) which is higher than the specified value (0.05), indicating a lack of statistically significant differences between the degree of answers Contractors, and the degree of answers construction project owners with regard to the factors influencing on quality. So rejected this hypothesis.

Table (4.38)
Arithmetic Mean and Standard Deviation for First Hypothesis

standard deviation	Arithmetic mean
0.95	3.17

Table (4.39)
The F-Test for First Hypothesis

Significance	F	R^2	R
0.195	1.693	0.008	0.089

This result is attributable to the contractor and the owner of construction project, are aware of the nature of the factors that influence on quality.

They also know the degree of influence of these factors through their experience of construction projects.

Second Hypothesis

The research Hypothesis:

H_o : The project owners give more importance for quality factors than the contractors.

The null hypothesis:

H_a : The project owners don't give more importance for quality factors than the contractors

Statement of hypothesis testing:

As shown from the below table (4.40) and table (4.41)that the level of importance of this hypothesis was high, averaging arithmetic (3.36), as was the test value (F) is equal to (1.823) the value of the probability (0.135) which is higher than the specified value (0.05), indicating a lack of statistically significant differences between the degree of answers Contractors, and the degree of answers construction project owners with regard to the importance for quality factors, which mean that, the project owners don't give more importance for quality factors than the contracting companies. So rejected this hypothesis.

Table (4.40)
Arithmetic Mean and Standard Deviation for Second Hypothesis

standard deviation	Arithmetic mean
0.87	3.36

Table (4.41)
The F-Test for Second Hypothesis

Significance	F	R^2	R
0.135	1.823	0.009	0.097

This result is attributable to the Contractor is aware of the importance of quality in construction projects, and cares greatly about it. In addition, the contractor is always trying to improve his work through his interest in the quality of the projects.

Third Hypothesis

The research Hypothesis:

H_o : There is a significance difference in perception between project owners and contractors regarded to the attention to quality in construction projects raises the total cost of the projects.

The null hypothesis:

H_a : There is no difference in perception between project owners and contractors regarded to the attention to quality in construction projects raises the total cost of the projects.

Statement of hypothesis testing:

Note from the below table (4.42) and table (4.43) that the level of importance of this hypothesis was high, averaging arithmetic (1.63), as was the test value (F) is equal to (0.047) the value of the probability (0. 534) which is higher than the specified value (0.05), indicating a lack of statistically significant differences between the degree of answers Contractors, and the degree of answers construction project owners with regard to the attention to quality in construction projects raises the total cost of the projects. So rejected this hypothesis.

Table (4.42)
Arithmetic Mean and Standard Deviation for Third Hypothesis

standard deviation	Arithmetic mean
0.97	1.63

Table (4.43)
The F-Test for Third Hypothesis

Significance	F	R2	R
0.534	0.047	0.003	0.036

This result is attributable to the contractor and the project owners know that increasing the quality of the project means an increase in the cost of the project.

In addition to the increased quality of the project require improving the quality of materials used, which will increase cost, leading to increased cost of the project.

Fourth Hypothesis

The research Hypothesis:

H_o : There is a significance in perception between project owners and contractors regarded to the role of management for producing better quality in construction projects.

The null hypothesis:

H_a : there is no a significance in perception between project owners and contractors regarded to the role of management for producing better quality in construction projects.

Statement of hypothesis testing:

Note from the below table (4.44) and table (4.45) that the level of importance of this hypothesis was high, averaging arithmetic (1.90), as was the test value (F) is equal to (0.058) the value of the probability (0. 415) which is higher than the specified value (0.05), indicating a lack of statistically significant differences between the degree of answers Contractors, and the degree of answers construction project owners with regard to management for producing better quality in construction projects. So rejected this hypothesis.

Table (4.44)
Arithmetic Mean and Standard Deviation for Fourth Hypothesis

standard deviation	Arithmetic mean
0.95	1.90

Table (4.45)
The F-Test for Fourth Hypothesis

Significance	F	R^2	R
0.415	0.058	0.004	0.049

This result is attributable to that there is a significant role played by the administration in maintaining the quality of construction projects, as well as the contractors and owners of construction projects are fully aware of this. Also, this result is attributable to the importance of the management to have a successful and interested in the quality of existing projects, where the absence of management control on projects lead to the creation of low-quality projects.

4.6 Theoretical Framework

The proposed framework that appears in figure (4. 4) gives us a clear conception about quality in construction projects, and what is the role of project management in achieving quality in addition to the activities that can be applied for quality in construction projects.

The framework is featured by the following according to (Yusof and Aspinwall, 2000):

1. Simple: easily used by the project parties (clients, owners, contractors, designers)
2. Easy to understand for all those interested in quality in construction projects.
3. Comprehensive: applies to many different types of projects.

4. Well structured: shows the most important elements and activities that help to achieve quality in construction projects and links between them.

5. Practical: does not need experts to explain.

6. Applicable: all elements are from real practice for construction projects.

All of these features applied to this proposed framework, that made it a method for achieving the objectives of this study which is to measure quality in construction projects, the development of performance and clients satisfaction in the end.

This framework covers the three phases of construction which are: construction inputs and planning, construction processing and construction outputs (Abdel-Razeq et al, 2001).

The beginning of the project is from clients needs, the basic requirements for effective quality management in construction projects are by the project management and according to Juran's philosophy, Middle management (Project Manager and his team) play a very important role in all phases of the project, in spite the role of Top management becomes more important in further strengthening quality if the current level of high quality.

The project management distributes tasks and responsibilities on three working teams (Joaquin et al, 2008):

1. The designing team: such as architect and civil engineers

2. Team of construction: such as contractors and suppliers

3. Team of implementation: the persons responsible for quality application such as quality Manager and consultant.

In the beginning the project management receives the needs of the client and then converts it into technical characteristics by the designing team, The designing team understands the needs and identifies the most important of these requirements, which are translated to construction specifications such as (drawings, plans, and schedules) to be given to the construction team for implementation (Joaquin et al, 2008).

In addition, the project management identifies the resources required to be achieved such as time, money, materials, equipment and people.

Quality policy is from top management tasks and it's a part of the strategic planning process. They reflect the attitudes and intentions of the

organization towards quality in projects to improve performance over the long term as well as the means to achieve it(McCabe, 1998).

To formulate quality policy ,the project management focuses on the client, where meetings between top management and staff are held to determine the vision in the field of quality, quality policy must be realistic and up to all members of the organization. The role of the implementation team is to review the quality policy as well as the responsibility in its application.

All the above is in the first phase construction inputs and planning the second stage is construction process, where the control process and monitoring of all inputs in the previous phase was through quality management systems such as quality control system and quality assurance system.

Quality assurance is the set of activities to ensure quality in construction process, which aims to prevent defects, focusing on the process used in the product, and through the development and testing process, therefore it will decrease defects (ISO 9000, 2005). In addition to prevention of quality problems through planned and systematic activities, considering quality assurance as a management tool.

The quality assurance system is found on three levels (Storey et al, 2000):

1. The organization level: deals with the quality policy and objectives
2. The functional level: deals with the general practices such as training
3. The operational level: dealing with Standard Operating Procedures

Quality control is a set of activities or techniques to achieve and maintain quality in a product or service in construction projects focusing on identifying and correcting defects, as well as to find and eliminate sources of quality problems that leads to poor quality performance by equipment and machinery in order to achieve client requirements.

Quality control system for a successful construction projects includes: construction, design , installation, inspect, documents and correct deficiencies (Satterfield, 2005).

Application of quality control system leads to (Mitra,1998):

1. Evolution in product quality or service quality
2. Improvement in productivity
3. Improvement in delivery times
4. Evaluate and modify this system constantly to achieve the changing needs of client.

In construction process there must be also a focus on the factors that influence quality, including raw materials, equipment, contract, Workers in the project, the manner of implementation of the project, systems and software used for quality control and public safety, Design, the nature of the project, match the specifications and standards, cost, training courses for staff in the field of quality and main contractor, observing it by the implementation team where it is evaluated and ranked according to the level of importance by contractors and owners. Attention to these factors leads to increasing the total cost of the project, through research and hypothesis which proved that there is no difference in viewpoints between contractors and owners toward concern for quality that leads to increase the cost of the project.

It is expected that if attention to all previous activities that lead to good performance, which in turn will generate client's satisfaction required. Show quality performance on two levels, at the company level and at the project level. The company-wide quality performance as a result of the publication of quality policy and strategies formulation process of construction workers, while involving the quality of performance at the project level through effective project and building a system of project management in general and quality management in the project in an optimal way (Koh et al, 2010).

The last phase of construction outputs it is the project itself.

Eventually after the implementation of all activities to achieve the objective of the project is the client's satisfaction achieved through the realization of requirements and needs and to meet the expectations because there is a direct correlation between client's needs and client's satisfaction.

Definition of quality by W. Edward Deming is the degree to which performance expectations of the client. By this definition, we will be able to measure quality by knowing the degree of satisfaction of the client and the degree of achievement of the project for its forecast and comparison between the needs and satisfaction of the client's.

Again the feedback loop the clients can reporting back to the project manger or the supplier on the quality performance. It is important because the manager and the employees can work together to improve the construction process.

The major purpose of quality management is to provide the information (flowing through a feedback loop) needed to take action with respect to a construction process (Gitlow et al, 2005) .

The generation of feedback provides the system performance information back into the loop to various elements that continues into the next cycle of production and improvement (Flynn et al. 1994).

This proposed framework is also featured by the following, in addition to the previous features (Joaquin et al, 2008):

1. It covered all phases of construction.
2. Taking into account the needs of the client and give it a priority instead of giving priority to designers.
3. This framework can be applied in numerous projects such as (civil engineering projects of various kinds).
4. Encourage communication between the client and the teams will raise the level of quality to obtain client's satisfaction.

The theoretical framework to measure quality in Appendix (V)

4.7 Quality Checklist:

Quality checklist is to ensure quality is planned in construction projects; lack of methods to measure quality makes its necessary to implement the theoretical framework and quality checklist in construction projects.

Quality checklist represents the practical application of the theoretical framework for measuring quality, is shown in table (4.46)

Table (4.46)
Quality Checklist

Comments	No	Yes	Items
			Are raw materials available and high quality?
			Are raw materials storage well?
			Is there a management system for raw materials and inventory?
			Are equipments available to suit project?
			Is there a management system for equipments?
			Is there a public safety system?
			Is there a quality assurance system?
			Is there a quality control system?
			Have all appropriate team members been notified of their required participation in quality policy?
			Does the project meet the requirements of the designer?
			Does the project meet the requirements of the owner?
			Does the project meet the requirements of regulatory

	agencies?
	Is the project free from defects?
	Was the project delivered on time?
	Was the project implemented within specified cost?
	Does the project have an approved quality management plan?
	Does the project fit the purpose?
	Is training provided to meet required competencies?
	Is the project pleasant to look?
	Is the client aware of his responsibility towards the quality acceptance?
	Have product, service and process quality standards been established, documented, and communicated?
	Does the organization manage the conditions under which work is performed, that are needed to achieve conformity to product requirements?
	Are there reports to monitor the contractor's performance?

4.8 Conclusions

The objectives of this study were achieved, which is to evaluate the factors affecting quality of construction projects in Jordan. Based on the results obtained after a proper analysis, a summary of conclusions of the study was the following:

1. Focus on the factors influencing on quality leads to improved quality, and upgraded with a lowest time and effort.
2. Checking the first research hypothesis, and prove that there is no difference between contractors and owners look at the factors affecting the quality of construction projects. The results concerned with first variable which measures the degree of awareness and attention to quality in the study sample that included owners and contractors showed that, the two parties of the sample study have high interest and awareness in quality, which was demonstrated by analyzing their answers using descriptive analysis, by calculating percentages and frequencies where the proportion of respondents interested in quality were high (48.2%).
3. Checking the second research hypothesis, and prove that owners do not give importance to the factors affecting quality more than contractors. The results of the second variable which is related to the evaluation of the factors influencing quality, and on the degree of influence from the perspective of owners and contractors in Jordan,

the arithmetic mean and standard deviation of each main factor and the dimensions of the factors, where the most influential factors on quality of both point of views were (raw materials, equipment, contract, workers in the project, manner of implementation of the project). The owners and contractors have the same opinion about the most influential factors on quality, because the parties are working in the same field, under the same conditions.

All values of the arithmetic mean of all main factors in addition to the dimensions were very close, from the owners and contractor point of views.

4. Checking the third research hypothesis, and prove that there is no difference between a contractor and an owner in the manner that high quality leads to high cost.

   But this contradicts the findings of (Suthummanon and Sirivongpaisal, 2006) which are: (1) there is a negative relationship between appraisal cost plus prevention cost and failure cost for material, labor, and company; (2) there is a positive relationship between appraisal cost plus prevention cost and quality for all factors; (3) there is a negative relationship between failure cost and quality for all components.

   Achieving quality in construction projects has economic consequences leading to reduce construction costs by eliminating the cost of correcting defects and errors, and the costs of implementing some of the rejected work, achieve user satisfaction and comfort ,and reduce maintenance costs during the period of use, thus contributing to increase the economic life of the constructions , gain operators' confidence , increase their share in the labor market and enable them to compete and to continue.

5. Checking the fourth research hypothesis ,and prove that project management plays an essential role in achieving better quality in construction projects.

   This is consistent with the search result of (Palaniandy, 2011) ,as there were four levels to provide quality management and control ,which are: Testing or inspection, quality control , quality assurance and total quality management.

   The basic function of the construction industry is to provide customers with projects, constructions and services, ready to use and achieve their requirements.

   Quality management is a management based on customer needs and requirements accurately, providing a secure environment and proper working conditions for these needs and requirements with the lowest cost and time possible through quality assurance at every stage of the construction process, and so quality is measured through customer

expectations, which means; the comparison between what they expect and what they realize.

6. In projects implemented by companies that do not contain a special quality section, where it does not have a system of quality management, quality of materials used are examined by contractors through an examining commission for materials in engineering laboratories, as for the quality of work during implementation stages, receipt or refusal of delivery, is drawing on the expertise of engineers overseers with no clear criteria and procedures governing quality.
7. Quality is the responsibility of all participants in the project with their different titles and responsibilities.
8. Lack and not obtaining clear specifications has a negative impact on quality of completed projects.
9. Owner's requirements are generally without clear and precise detail which affects negatively on work results.
10. Contract documents are limited to price and time, it doesn't include other requirements such as plans and quality programs.
11. Lack of procedures to identify training programs , leading to the neglect of staff training which is reflected negatively on performance and leads to poor quality improvement process.
12. Reliance on preventive remedial actions leading to avoid many errors.
13. Lack of a quality manual which is reflected negatively on the application of quality system.

4.9 Recommendations:

From the previous results, there are some recommendations can be presented:

1. Contractors and owners should be interested in quality management system in the projects ,due to its role in fast delivery and quality performance and cost.
2. Dissemination of quality on all activities instead of focusing on the quality of the final product because it is the most important way to attract customers and enhance competitiveness.
3. Reviewing the contract and ensure that all quality requirements in the contract are clear and ensure the ability of the contractor to implement it.
4. Paying attention to training and development of personnel skills working with the owner or contractor, to contribute to the improvement of their performance, increase their capabilities and

develop their knowledge about project management and quality management in particular.

5. Emphasizing the role of the owner in the project implementation procedures through:
    5.1 The owner should prepare the work site to be clean and free of obstacles
    5.2 The owner shouldn't require difficult obtaining materials
    5.3 Do not delay in making payments to the contractor
    5.4 The owner shouldn't delay in providing the contractual responsibility of materials, equipment and documentations needed for the project.
    5.5 The owner shouldn't choose the contractor of the lowest prices, but the contractor is chosen by his experience and reputation.
6. Emphasizing the direct role of the contractor .
    6.1 The choice of materials used in the project, depending on its quality and not by price
    6.2 Selection of personnel according to competence and experience.
    6.3 Commitment to the duration of the implementation.
7. Developing criteria for the requirements and specifications of each project and compare their achievements , identifying errors and appropriately corrective action to be done.
8. Studying time needed to implement the project before signing contracts and not the adoption of short-term and insufficient supply.
9. Organization of work of the projects and avoid randomness by selecting tasks and responsibilities of each individual to achieve quality.

4.10 Limitations

1. Only the contractors registered in the Jordanian Constructions Contractors Association will be involved in this study.
2. This research is involved with construction building projects only (housing, schools, college, etc.), and will not take the consideration for other construction projects like (bridges, highways), or industrial projects (factories and workshops), and other projects (sewage and water supply). In addition the time limitation.

4.11 Future Works

1. Study of quality problems in construction projects
2. Factors affecting the cost of construction projects
3. Factors affecting the quality performance in construction projects
4. Factors affecting the delay in construction projects
5. Factors that affect process quality in construction projects
6. Quality control and quality assurance in construction projects

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Appendix I
English Questionnaire

Mu'tah University

<u>Questionnaire</u>

Dear Sirs,

We undertaking a survey to evaluate the factors affecting on the quality in construction projects from the perspective of the contractor and the owner, this will lead to develop the framework to measure the quality in construction project in Jordan.

please make sure your participation is critical for the success of this study, all data included in this questionnaire will be used only for academic research.

This study is undertaken as a partial fulfillment for the requirement of master of Engineering Management (MEM)-

program, and a copy of the study results will be furnished to you upon your request.

Yours sincerely

Supervisor	**Researcher**
Prof. Dr. Sultan Al-Tarawneh	**Aswan Sabri Al-Dalaeen**
Mu'tah University	**Mu'tah University**

Part One: General Information

Please answer the following questions:

1- Please choose what suits you best

□ Contractor □ owner

2- Job title: …………………………………………………

3- Educational level: …………………………………..

4- years of experience: ………………………………..

5- Type of classification for contracting companies:

□ First class □ Second class □ Third class □ Fourth class □others

6- Number of projects implemented in the last five years:

□ less than 15 □ 15 to 24 □ 24 to 35 □ More than 35

7- Type of implemented projects:

□ Infrastructure □ Construction □ others

Part Two: Awareness and Concern of Quality

1- The attention rate of quality

□High □Mid-rate □Low rate □Never

2- The number of staff involved in quality:

□No employees □1 □2 to 4 □More than 4

3- A system to improve quality within the company is applied?

□No □Recently □yes, long time □under consideration

4- The contracting company is ISO certified?

□Yes □No

5- The concept of quality in your opinion is best suited as:

□Conformance to requirements and specifications □Reduction in defects

□The customer satisfaction achievement □Reduction in total cost

6- Paying attention to quality, raises the total cost of projects?

□Yes □No

7- Project management plays a fundamental role in ensuring quality in construction projects?

□Yes □No

Part Three: Influence of Factors on Quality in Construction Projects

Please specify the degree of influence each of the following factors on quality in construction projects

Factors	**The Degree of Influence**			
	Large	**Medium**	**Few**	**Ineffective**
Raw materials				
1-Availability of raw materials and high quality				
2- Storage of materials well				
3- A management system for				

raw materials and inventory				
4- The use of local materials				
5- The use of imported materials				
Equipment				
6-Provide equipment to suit project				
7-Use proper equipment required				
8-Equipment usable in all times				
9-Maintenance of equipment are available and in good price				
10- A system for equipment management				
11- The existence of technicians and qualified drivers				
Contract				
12- Unified contract system				
13- clarity of the conditions contained in the contract				
14- The distribution of tasks and responsibilities between the parties involved in the contract				
Factors	**The Degree of Influence**			
	Large	**Medium**	**Few**	**Ineffective**
Workers in the project				
15- Experience of workers in the project				
16- Training of workers in the project				
17-Instructions and administrative system of management of the personnel				
18- A system of incentives for workers in the project				

19- Workers ' salaries commensurate with experience				
The manner of implementation of the project				
20 - Ongoing follow-up and supervision of the project				
21- Executive graphics processing in time				
22- Receipt of the executed works properly and timely				
23- A management system for the follow-up of the project				
24- Using the latest means of implementation at all stages of implementation				
25- Reduce change orders				
Systems and software used for quality control and public safety				
26- Using modern and effective applications				
27- Public safety programs				
28- Application of control systems and quality management				
29 - Application software, systems cost control				
Factors	**The degree of influence**			
	Large	**Medium**	**few**	**Ineffective**
Design				
30- Match specifications and codes of engineering				
31- Clearly , accurately and comprehensively designs				
32- Experience in designer				
33- Clearly the table amounts for specs and prices				
34- Speed completion of detailed design				

The nature of the project				
35- The nature, type and complexity of the project				
36- The duration of the project				
37- The site and the location of the project				
38- Easy access to project				
39- The cleanliness of the general location of the project				
Match specifications and standards				
40- The application and adherence to the standards and specifications contained in the plans and designs and quantities				
Cost				
41- The cost of equipment				
42- The cost of raw materials and materials needed for the project				
43- The cost of project personnel				
44- The cost of repairing the defects of the project				

Factors	**The degree of influence**			
	Large	**Medium**	**few**	**Ineffective**
Training courses and meetings in the field of quality				
45- Training courses for staff in the field of quality				
46- Meetings of the Working Group to emphasize the importance of quality				
Main contractor				
47- The contractor and the degree of experience rating				

48- The amount of cash flow for the contractor				
49- The continuing cooperation between the main contractor and sub contractor				
50- The continuing cooperation between the main contractor and supervision				
51- The ongoing cooperation between the contractor and the owner				

Thank you for your cooperation. Your time and effort is appreciated, if you would like a copy of the results, please provide your email address in the space provided

………………………………………………………………………..

Appendix II
Arabic Questionnaire

جامعة مؤتة

استبانه

السادة الكرام:

نقوم بعمل مسح ميداني نقيم من خلاله العوامل المؤثرة على الجودة في مشاريع الإنشاءات في الأردن من وجهة نظر المقاول والمالك، وبالتالي سنقوم بعمل إطار نظري لقياس الجودة في المشاريع الإنشائية.

يرجى من حضرتكم التأكد إن مشاركتكم مهمة لنجاح هذه الدراسة وذلك بملء هذه الاستبانة بمعلوماتكم الدقيقة علما أن جميع المعلومات سوف تعامل بسرية تامة وتستخدم لغايات البحث العلمي فقط.

تجري هذه الدراسة استكمالا لمتطلبات الحصول على درجة الماجستير في الإدارة الهندسية. سنقدم نسخة من نتائج الدراسة لجميع المهتمين والمشاركين في هذه الاستبانة بناء على طلبكم.

شاكرين لكم حسن تعاونكم

المشرف
ا.د سلطان الطراونة
جامعة مؤتة/كلية الهندسة

الباحث
أسوان صبري الضلاعين
جامعة مؤتة/كليةالهندسة

الجزء الأول: معلومات عامة

أرجو الإجابة على الأسئلة التالية :

1- أرجو اختيار ما يناسبك
□ مقاول □ مالك

2- المسمى الوظيفي:...
3- المؤهل العلمي :..
4- عدد سنوات الخبرة:..
5- درجة تصنيف شركة المقاولات:
□ درجة أولى □ درجة ثانية □ درجة ثالثة □ درجة رابعة □ أخرى

6- عدد المشاريع التي تم تنفيذها خلال الخمس سنوات الماضية:
□ أقل من 15 □ 15 – 24 □ 25– 35 □35 فأكثر

7- نوعية المشاريع التي تم تنفيذها:
□ بنية تحتية □ إنشاءات □ أخرى

الجزء الثاني:مدى الوعي والاهتمام بالجودة

1-معدل الاهتمام بالجودة:
عالي □ متوسط □ بسيط □لا يوجد اهتمام□

2- عدد الموظفين المعنيين في الشركة بالجودة:
□لا يوجد □1 □2 – 4 □ 5فأكثر

3- يتم تطبيق نظام لتحسين الجودة داخل الشركة ؟
□ لا □ حديثا □ نعم ،منذ زمن □ تحت التجربة للتطبيق

4- هل الشركة حاصلة على شهادة الأيزو؟
نعم □ لا□

5- مفهوم الجودة الأنسب في نظرك هو:
□ القدرة على أرضاء العميل □ مطابقة المنتج للمتطلبات والمواصفات
□النجاح في خفض التكاليف □ انخفاض نسبة العيوب

6- الاهتمام بالجودة يؤدي إلى رفع الكلفة الإجمالية للجودة؟
نعم □ لا□

7- إدارة المشروع تلعب دورا أساسيا في ضمان الجودة في المشاريع الإنشائية؟
نعم □ لا□

الجزء الثالث:تأثير العوامل على الجودة فى المشاريع الإنشائية

أرجو تحديد درجة تأثير كل من العوامل التالية على الجودة في المشاريع الإنشائية

العوامل	درجة التأثير			
	كبيرة	متوسطة	قليلة	غير مؤثر
المواد الخام				
1- توفر المواد الخام وبجودة عالية				
2- تخزين المواد بشكل جيد				
3- وجود نظام لإدارة المواد الخام والمخزون				
4- استخدام مواد محلية				
5- استخدام مواد مستوردة				
المعدات				
6- توفر المعدات بشكل يناسب المشروع				
7- استخدام المعدات بالشكل الصحيح والمطلوب				
8- المعدات صالحة للاستعمال في كافة الأوقات				
9- صيانة المعدات متوفرة وبسعر جيد				
10-وجود نظام لإدارة المعدات				
11-وجود فنيين وسائقين أكفاء				
العقد				
12-استخدام نظام العقد الموحد				
13-وضوح الشروط الواردة في العقد				
14-توزيع المهام والمسؤوليات بين الأطراف المشاركة في العقد				
العاملين في المشروع				
15-خبرة العاملين في المشروع				
16-تدريب العاملين في المشروع				
17-وجود تعليمات ونظام إداري لتنظيم شؤون العاملين				
18-وجود نظام حوافز للعاملين في المشروع				
19-رواتب العاملين تتناسب مع خبراتهم				
طريقة تنفيذ المشروع				
20-المتابعة والإشراف المستمرين على المشروع				
21-تجهيز الرسومات التنفيذية في الوقت المناسب				
22-استلام الأعمال المنفذة بالطريقة السليمة والوقت المناسب				
23-وجود نظام إداري لمتابعة المشروع				
24-استخدام احدث وسائل التنفيذ في جميع مراحل التنفيذ				
25- التقليل من الأوامر التغييرية				
العوامل	**درجة التأثير**			

	كبيرة	متوسطة	قليلة	غير مؤثر
الأنظمة والبرامج المستخدمة لضبط الجودة والسلامة العامة				
26- استخدام برامج وتطبيقات حديثة وفعالة				
27- تطبيق برامج السلامة العامة				
28- تطبيق أنظمة المراقبة وإدارة الجودة				
29- تطبيق برامج وأنظمة ضبط الكلفة				
التصميم				
30- مطابقة المواصفات والكودات الهندسية				
31- وضوح ودقة وشمولية التصاميم				
32- خبرة المصمم				
33- وضوح جدول الكميات للمواصفات والأسعار				
34- سرعة انجاز التصاميم التفصيلية				
طبيعة المشروع				
35- طبيعة ونوع ودرجة تعقيد المشروع				
36- مدة المشروع				
37- موقع ومكان المشروع				
38- سهولة الوصول للمشروع				
39- نظافة الموقع العام للمشروع				
مطابقة المواصفات والمقاييس				
40- التطبيق والالتزام بالمواصفات والمقاييس الواردة في المخططات والتصاميم وجدول الكميات				
التكلفة				
41- تكلفة المعدات				
42- تكلفة المواد الخام والمواد اللازمة للمشروع				
43- تكلفة العاملين في المشروع				
44- تكلفة إصلاح عيوب المشروع				
الدورات التدريبية والاجتماعات في مجال الجودة				
45- عقد دورات تدريبية لفريق العمل في مجال الجودة				
46- عقد اجتماعات لفريق العمل للتأكيد على أهمية الجودة				
المقاول الرئيسي				
47- خبرة المقاول ودرجة تصنيفه				
48- مقدار التدفق النقدي للمقاول				
العوامل	**درجة التأثير**			

	كبيرة	متوسطة	قليلة	غير مؤثر
49- التعاون المستمر بين المقاول الرئيسي والمقاول الباطن				
50- التعاون المستمر بين المقاول الرئيسي والإشراف				
51- التعاون المستمر بين المقاول والمالك				

مرة أخرى نشكر لكم تعاونكم. وفي حال الرغبة في الحصول على نسخة من النتائج نرجو تزويدنا بالبريد الإلكتروني ....

Appendix III
List of Arbitrators

Position	**Place**	**Name**	**No.**
Teacher Associate Business Administration Faculty	Al-Balqa' Applied University- Jordan	Dr. Sattam Al-amro	**1**
Owner Representative	Al-Balqa' Applied University- Jordan	Dr. Satie Al-dalaeen	**2**
Teacher Assistant Social Science Faculty	Al-Balqa' Applied University- Jordan	Dr. Alaa Al-majali	**3**
Professor Engineering Faculty	Mu'tah University- Jordan	Dr. Abbas Ajjam	**4**
Contractor	Jordan – Al-karak	Eng. Ameera Al-dmour	**5**

Appendix V
Theoretical Framework to Measure Quality